HUMAN MARS MISSION

Launch Window from Earth Orbit

FINAL REPORT

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(Part I)

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Submitted to:
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Introduction

The determination of orbital window characteristics is of major importance in the analysis of human interplanetary missions and systems. The orbital launch window characteristics are directly involved in the selection of mission trajectories, the development of orbit operational concepts, and the design of orbital launch systems.

The orbital launch window problem arises because of the dynamic nature of the relative geometry between outgoing (departure) asymptote of the hyperbolic escape trajectory and the earth parking orbit. The orientation of the escape hyperbola asymptotic relative to earth is a function of time. The required hyperbola energy level also varies with time. In addition, the inertial orientation of the parking orbit is a function of time because of the perturbations caused by the Earth's oblateness. Thus, a coplanar injection onto the escape hyperbola can be made only at a point in time when the outgoing escape asymptote is contained by the plane of parking orbit. Even though this condition may be planned as a nominal situation, it will not generally represent the more probable injection geometry. The general case of an escape injection maneuver performed at a time other than the coplanar time will involve both a path angle and plane change and, therefore, a ΔV penalty. Usually, because of the ΔV penalty the actual departure injection window is smaller in duration than that determined by energy requirement alone.

This report contains the formulation, characteristics, and test cases for five different launch window modes for Earth orbit.
These modes are:
(1) One impulsive maneuver from a Highly Elliptical Orbit (HEO)
(2) Two impulsive maneuvers from a Highly Elliptical Orbit (HEO)
(3) One impulsive maneuver from a Low Earth Orbit (LEO)
(4) Two impulsive maneuvers from LEO
(5) Three impulsive maneuvers from LEO

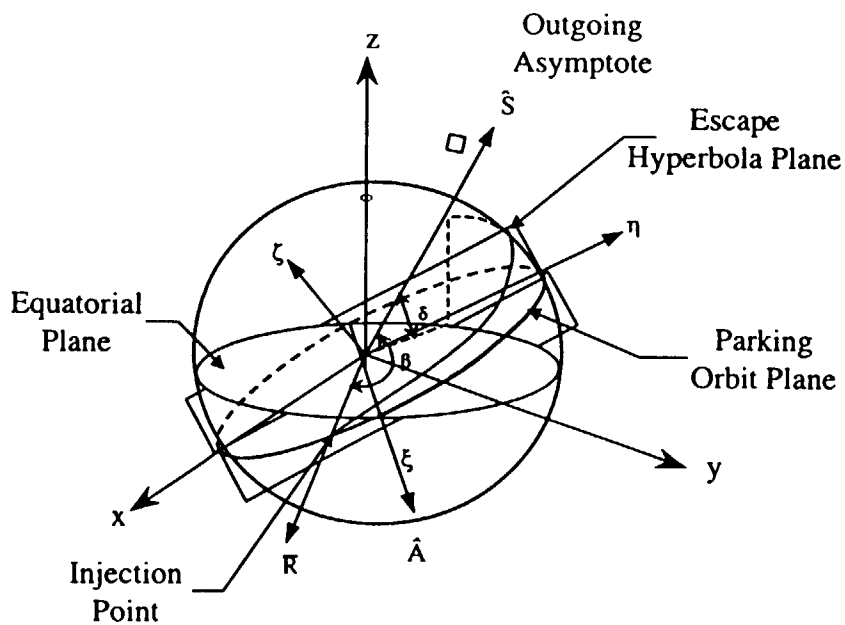
The formulation of these five different launch window modes provides a rapid means of generating realistic parametric data for space exploration studies. Also the formulation provides vector and geometrical data sufficient for use as a good starting point in detail trajectory analysis based on calculus of variations, steepest descent, or parameter optimization program techniques.

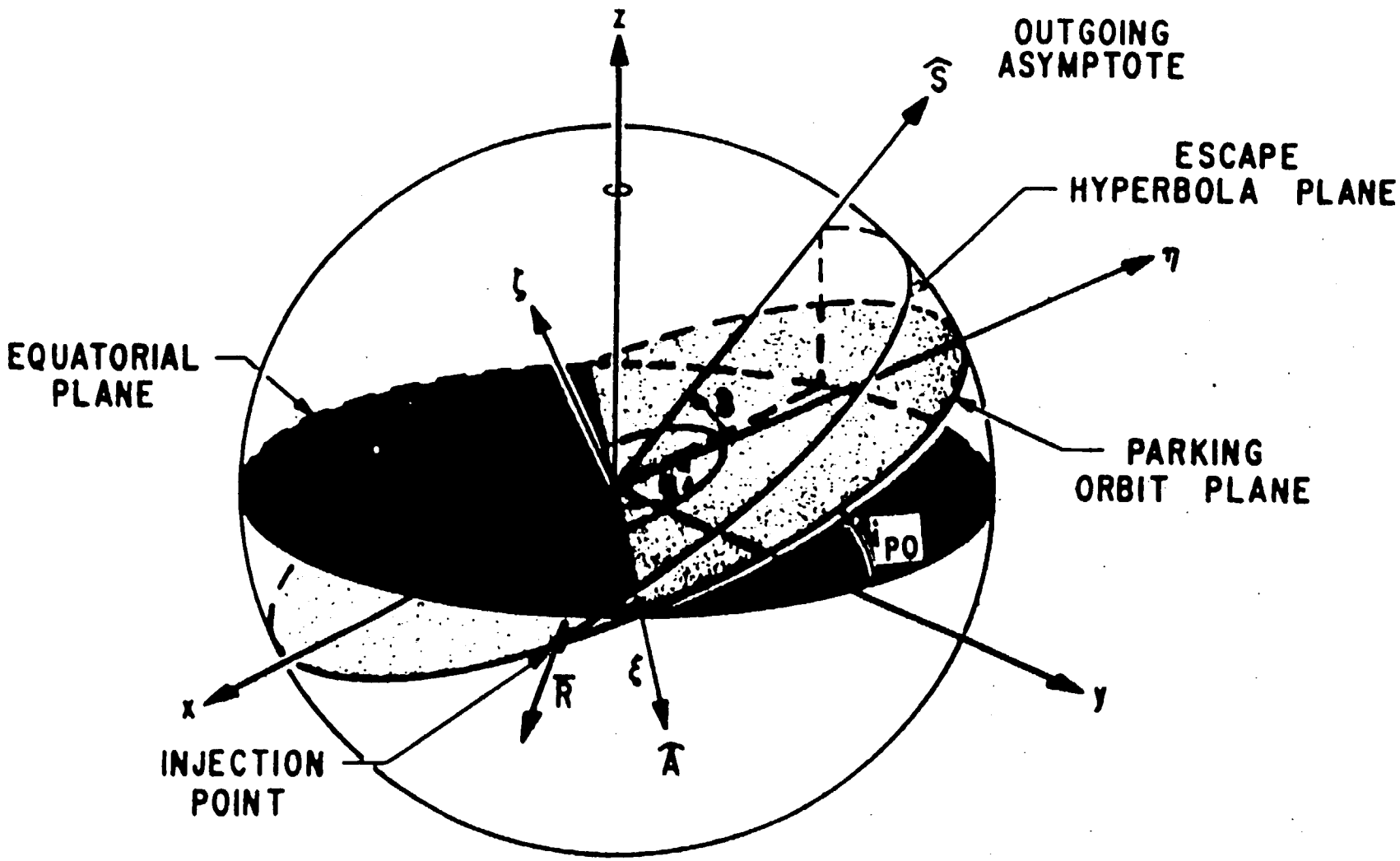
NON-COPLANAR ORBITAL LAUNCH GEOMETRY

The basic geometry of the completely general, non-coplanar orbital launch geometry is illustrated in this chart. The parking orbit plane is defined by orbit inclination and orbit ascending node. The escape hyperbolic conditions are defined by the outgoing asymptote vector ($\bar{S}$) right ascension (α) declination (δ) and C_3 (twice the total hyperbolic escape energy per unit mass). The parking orbit ascending node has a regression rate of -5.0 to -7.2 degrees per day for Low Earth Orbit (LEO). The angular orientation (α and δ) of the outgoing asymptote changes much slower, less than 1 degree per day. Because of the LEO regression rate, co-planar launch geometry exists for only a short period of time.

High Earth Orbit (HEO) (orbit period ~24 hour) ascending node regression rate is much smaller, ~ -0.10 degree per day. The required plane change between the HEO and the outgoing asymptote does not build up as fast as in the LEO case. The HEO conditions would exist for the SEP architecture. And the LEO conditions would exist for the nuclear thermal and chemical high thrust architectures.

Figure 1. Non-Coplanar Orbital Launch Geometry




z
OUTGOING
ASYMPTOTE
$\hat{S}$
ESCAPE
HYPERBOLA PLANE
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EQUATORIAL
PLANE
PARKING
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INJECTION
POINT

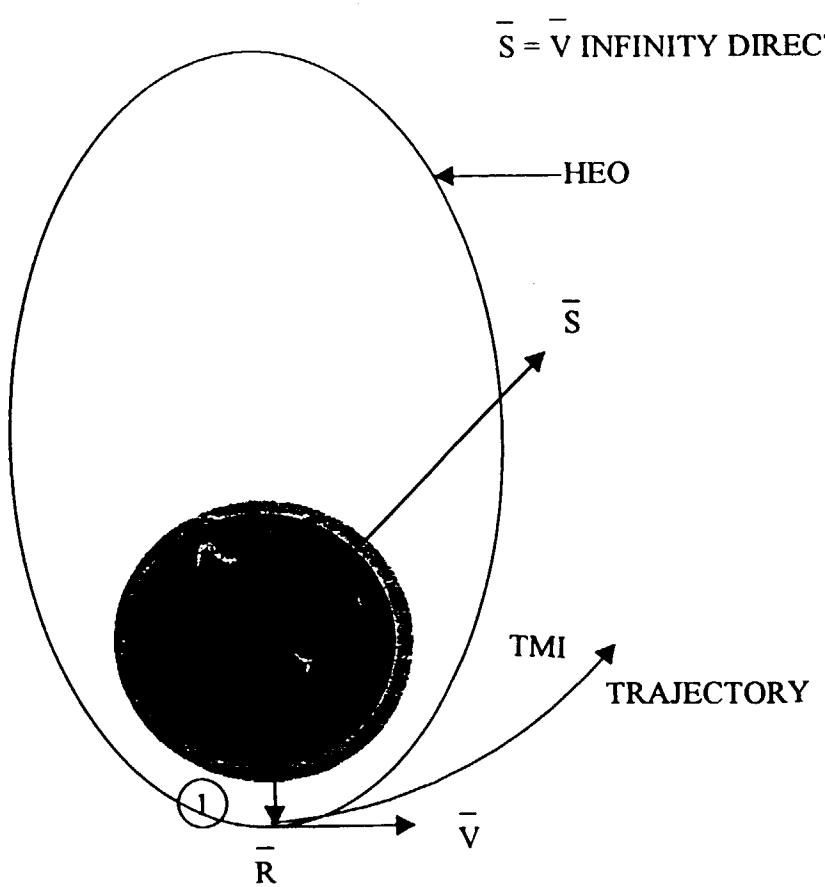
LAUNCH WINDOW FROM A HIGH ELLIPTICAL ORBIT (HEO)

The duration of a planetary launch window depends on the orbital dynamic change between the orbit plane and outgoing asymptote vector ($\bar{S}$) and the hyperbolic energy level required for the earth's Trans-Mars injection (TMI). The parameters that affect the orbital launch window include the parking orbit inclination, perigee altitude, apogee altitude, and the declination and right ascension of the outgoing asymptote vector ($\bar{S}$).

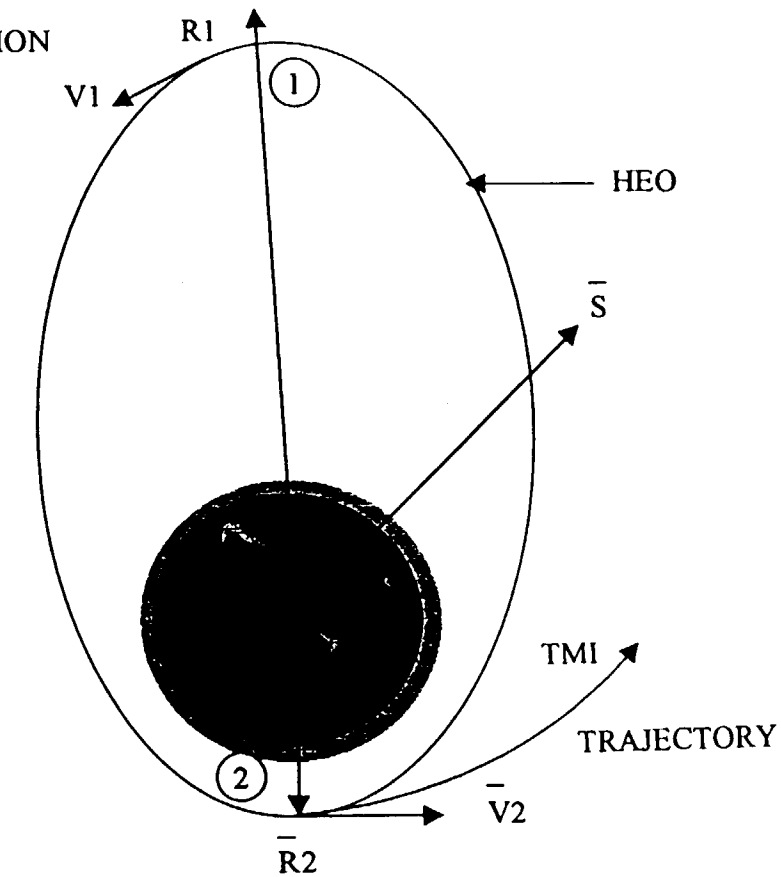
This chart shows the orbital geometry for a one burn maneuver and a two burn maneuver to achieve TMI from a High Elliptical Orbit (HEO). When the angle between the orbit plane and the outgoing asymptote vector ($\bar{S}$) is small, the TMI may be made efficiently with a single burn maneuver. The single burn maneuver will include an orbit energy change combined with a plane change. When the angle between the orbit plane and $\bar{S}$ is large, however, the Δv requirement can be prohibitively large. Thus a more efficient means of attaining TMI is desired. This can be achieved by dividing the TMI maneuver into two burns. The first burn maneuver is made near the HEO apogee, at point (1), which change the HEO plane to contain the outgoing asymptote vector, creating an inplane maneuver for the second burn near HEO perigee, at point (2) to complete TMI.

Both the single burn maneuver and two burn maneuver results need to be determined across the duration of the launch window to identify which is the more efficient on a given day.

LAUNCH WINDOW FROM A HIGH ELLIPTICAL ORBIT (HEO)



1 ONE BURN MANEUVER
FOR TMI (INCLUDES PLANE CHANGE)



TWO BURN MANEUVER
1 PLANE CHANGE BURN
2 TMI BURN

LAUNCH WINDOW FROM LOW EARTH ORBIT (LEO)

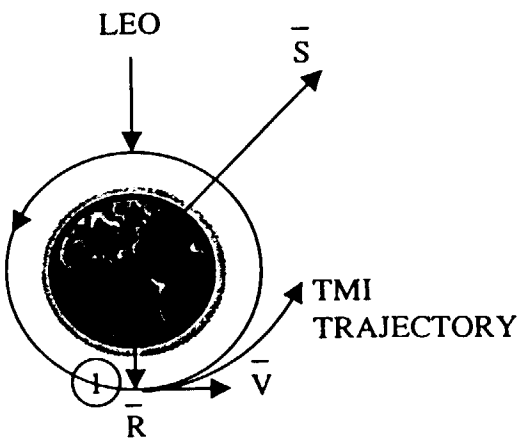
This chart shows the orbital geometry for a one, two and three burn maneuver to achieve Trans-Mars Injection (TMI). The one burn maneuver, which includes an orbit energy change combined with a plane change, is made near the LEO perigee. When the thrust to initial weight ratio is relatively high (≥ 0.6) and the required plane change angle is small ($\leq 3.0°$) the one burn maneuver would be efficient to achieve TMI. When the thrust to initial weight ratio is relative low(≤ 0.25) and the required plane change is low ($\leq 3.0°$) the two burn maneuver would be more efficient than the one burn maneuver because the gravity loss would be considerably lower. The first burn would place the Mars' vehicle into an intermediate ellipse (~4.8 hr period) where the vehicle would coast one orbit back near perigee (at point (2)). At this point the second burn is made which includes an orbit energy change and a plane change to achieve TMI.

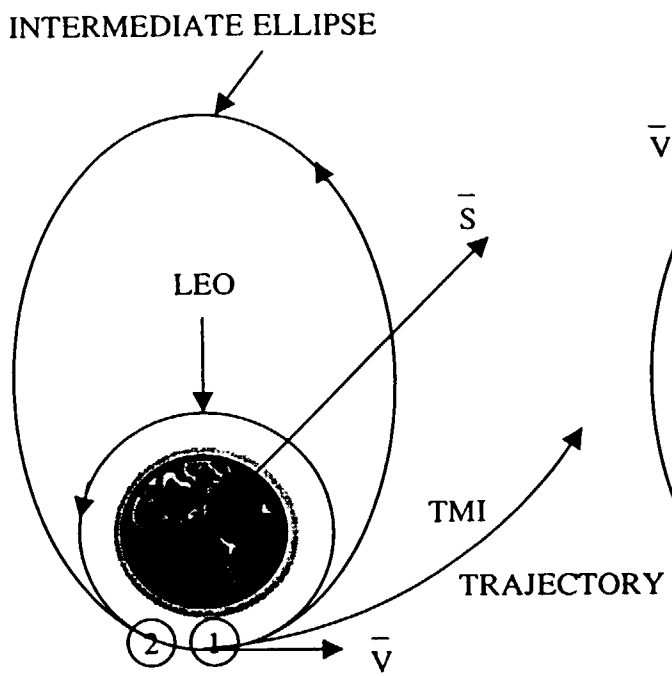
The three burn maneuver for TMI may be more efficient when the thrust to initial weight ratio is low (≤ 0.25) and the required plane change is greater than three degrees. The first burn places the Mars vehicle into an intermediate ellipse (~4.8 hr period). The vehicle coasts to just past apogee of the intermediate ellipse where a second burn is made to change the intermediate orbit plane to contain the outgoing asymptote vector (S^-). After the second burn the vehicle coasts back to near perigee where the third burn, inplane, maneuver is made to achieve TMI.

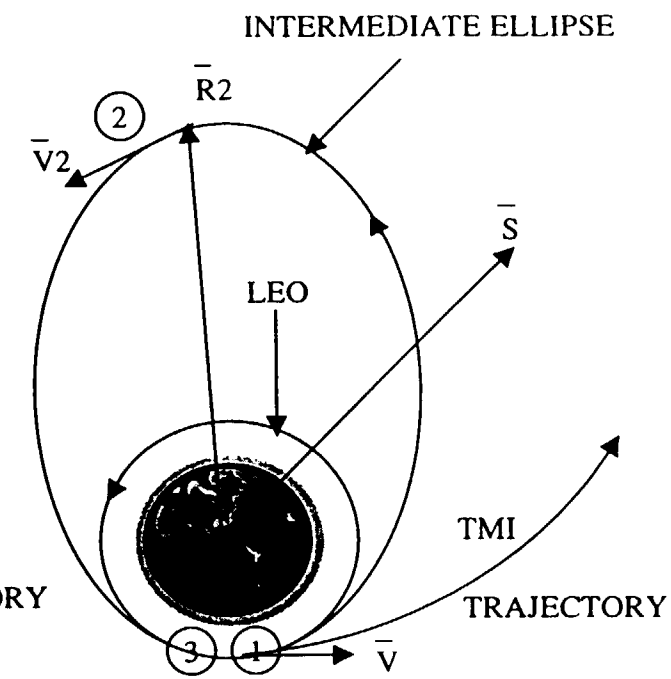
The results from all three different types of burn maneuvers need to be determined across the duration of the launch window to identify which is the most efficient on a given day.

LAUNCH WINDOW FROM LOW EARTH ORBIT (LEO)

$\bar{S} = \bar{V}$ INFINITY DIRECTION







1 ONE BURN MANEUVER FOR TMI (INCLUDES PLANE CHANGE)

TWO BURN MANEUVER
1 BURN INTO INTERMEDIATE ELLIPSE (~ 4.8 HR PERIOD)
2 TMI BURN (INCLUDES PLANE CHANGE)

THREE BURN MANEUVER
1 BURN INTO INTERMEDIATE ELLIPSE (~ 4.8 HR PERIOD)
2 PLANE CHAGE BURN
3 TMI BURN

[illegible] Case

(Converged)

PERFORMANCE SUMMARY

Stay Time (days)	Depart		Arrive		Flight Time (days)
	Earth	JAN 2, 2014, 18.0000 hours GMT Julian Date 56660.2500	Mars	JUL 21, 2014, 18.0000 hours GMT Julian Date 56860.2500	200.0000
529.0042	Mars	JAN 1, 2016, 18.1012 hours GMT Julian Date 57389.2542	Earth	JUL 9, 2016, 18.1012 hours GMT Julian Date 57579.2542	190.0000
				Total Duration	919.0042

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Depart Engine	Depart Propell	Depart Tankage	Arrive Engine	Arrive Propell	Arrive Tankage	Inert	Probes	AeroBrk	Drops	Samples	NetMass
1	100.580	6.000	18.263	0.000	0.000	0.000	0.000	0.600	17.312	13.100	0.000	0.000	45.305
2	45.905	6.300	9.245	0.000	0.000	0.000	0.000	0.600	23.560	0.000	0.000	0.000	6.200

DEPARTURE/ARRIVAL CONDITIONS

Leg	Depart V Inf (km/s)	Depart Decl (deg)	Depart Rt Asc (deg)	Depart Brn Tm (min)	Depart Del V (km/s)	Depart VLoss (m/s)	Arrive V Inf (km/s)	Arrive Decl (deg)	Arrive Rt Asc (deg)	Arrive Brn Tm (min)	Arrive Del V (km/s)	Arrive VLoss (m/s)
1	3.07510	-10.15	169.52	12.564	0.91057	12.521	5.45117	-6.97	314.16	0.000	0.00000	0.000
2	2.79973	22.29	160.17	6.068	0.97501	2.970	6.81300	15.54	84.03	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.2579239	0.219942932	1.23779	281.99267	171.36358	8.71725	156.81879	0.9812524	1.5345954	515.32354
2	1.3029496	0.287871017	1.65105	107.77939	232.40005	194.26408	307.54150	0.9278682	1.6780310	543.23764

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
800.00000	51.60000	0.91057	-48.07849	115.71342	-0.26395	0.54812	-0.67752
800.00000	51.60000	0.91057	34.12085	128.88116	-0.47318	0.58681	0.51078

MISSION OPERATIONS

	Earth Dep	Earth Helio	Mars Arr	Mars Dep	Mars Helio	Earth Arr
Times (days)						
Depart/Arrive	0.00		200.00	729.00		919.00
Flight/Stay		200.00	529.00		190.00	
Esc/Cap Orbits (radii)						
Apoapse Distance	12.09		0.00	10.95		0.00
Periapse Distance	1.13		0.00	1.07		0.00
Spacecraft Distances (AU)						
Minimum Heliocentric		0.9833			1.0166	
Maximum Heliocentric		1.5004			1.6574	
Geocentric	0.0000		1.1244	1.6764		0.0000
Maneuvers						
Propulsion Type	Vloss		None	Vloss		None
Vinf (km/sec)	3.08		5.45	2.80		6.81
Eff Delta-V (km/sec)	0.91	0.00	0.00	0.98	0.00	0.00
Vel Losses (m/sec)	12.52		0.00	2.97		0.00
Propellant (kg or t)	18.26	0.00	0.00	9.25	0.00	0.00
Burn time (hr)	0.21		0.00	0.10		0.00
Thrust (lbs or klbs)	24.75		0.00	24.75		0.00
Spec Imp (sec)	463.4		0.0	442.1		0.0
Mass Changes (kg or t)						
Dry Stage Jettisoned	6.00		0.00	6.30		0.00
Probes Separated			17.31			23.56
AeroBrake Separated			13.10			0.00
Drop Mass Left			0.00			0.00
Sample Mass Added			0.00			0.00

[illegible] Case

[illegible] (Converged)

PERFORMANCE SUMMARY

Leg	Stay Time (days)	Depart		Arrive		Flight Time (days)
1		Earth	JAN 3, 2014, 12.0000 hours GMT Julian Date 56661.0000	Mars	JUL 21, 2014, 19.1299 hours GMT Julian Date 56860.2971	199.2971
2	504.0048	Mars	JAN 1, 2016, 16.8446 hours GMT Julian Date 57389.2019	Earth	JUL 9, 2016, 16.8446 hours GMT Julian Date 57579.2019	190.0000
					Total Duration	918.2019

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Depart Engine	Depart Propell	Depart Tankage	Arrive Engine	Arrive Propell	Arrive Tankage	Inert	Probes	AeroBrk	Drops	Samples	NetMass
1	99.753	6.000	18.191	0.000	0.000	0.000	0.000	0.000	17.312	13.100	0.000	0.000	45.150
2	45.150	6.300	9.092	0.000	0.000	0.000	0.000	0.000	23.558	0.000	0.000	0.000	6.200

DEPARTURE/ARRIVAL CONDITIONS

Leg	Depart V Inf (km/s)	Depart Decl (deg)	Depart Rt Asc (deg)	Depart Brn Tm (min)	Depart Del V (km/s)	Depart VLoss (m/s)	Arrive V Inf (km/s)	Arrive Decl (deg)	Arrive Rt Asc (deg)	Arrive Brn Tm (min)	Arrive Del V (km/s)	Arrive VLoss (m/s)
1	3.09071	-9.62	169.14	12.514	0.91492	12.491	5.45000	-7.08	314.19	0.000	0.00000	0.000
2	2.79973	22.27	160.20	5.968	0.97492	2.872	6.81901	15.54	84.02	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.2576872	0.220094935	1.21414	282.75585	170.60346	9.47860	156.84119	0.9808766	1.5344978	515.17808
2	1.3028137	0.287955829	1.65118	107.72949	232.45981	194.23112	307.48171	0.9276609	1.6779664	543.15262

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
800.00000	51.60000	0.91492	-47.77069	116.02540	-0.26981	0.55257	-0.67746
800.00000	51.60000	0.91492	34.47833	128.43679	-0.46885	0.59077	0.51793

MISSION OPERATIONS

	Earth Dep	Helio	Mars Arr	Mars Dep	Helio	Earth Arr
Times (days)						
Depart/Arrive	0.00		199.30	728.20		918.20
Flight/Stay		199.30		528.90	190.00	
Esc/Cap Orbits (radii)						
Apoapse Distance	12.09		0.00	10.95		0.00
Periapse Distance	1.13		0.00	1.07		0.00
Spacecraft Distances (AU)						
Minimum Heliocentric		0.9833			1.0166	
Maximum Heliocentric		1.5004			1.6574	
Geocentric	0.0000		1.1247	1.6769		0.0000
Maneuvers						
Propulsion Type	Vloss		None	Vloss		None
Vinf (km/sec)	3.09		5.45	2.80		6.82
Eff Delta-V (km/sec)	0.91	0.00	0.00	0.97	0.00	0.00
Vel Losses (m/sec)	12.49		0.00	2.87		0.00
Propellant (kg or t)	18.19	0.00	0.00	9.09	0.00	0.00
Burn time (hr)	0.21		0.00	0.10		0.00
Thrust (lbs or klbs)	24.75		0.00	24.75		0.00
Spec Imp (sec)	463.4		0.0	442.1		0.0
Mass Changes (kg or t)						
Dry Stage Jettisoned	6.00		0.00	6.30		0.00
Probes Separated			17.31			23.56
AeroBrake Separated			13.10			0.00
Drop Mass Left			0.00			0.00
Sample Mass Added			0.00			0.00

File Name: Loaded Case

(Converged)

PERFORMANCE SUMMARY

Leg	Stay Time (days)	Depart		Arrive		Flight Time (days)
1		Earth	JAN 4, 2014, 12.0000 hours GMT Julian Date 56662.0000	Mars	JUL 21, 2014, 19.2000 hours GMT Julian Date 56860.3000	198.3000
	528.9542	Mars	JAN 1, 2016, 18.1008 hours GMT Julian Date 57389.2542	Earth	JUL 9, 2016, 18.1008 hours GMT Julian Date 57579.2542	190.0000
					Total Duration	917.2542

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Depart Engine	Depart Propell	Depart Tankage	Arrive Engine	Arrive Propell	Arrive Tankage	Inert	Probes	AeroBrk	Drops	Samples	NetMass
1	100.837	6.000	18.520	0.000	0.000	0.000	0.000	0.600	17.312	13.100	0.000	0.000	45.305
2	45.905	6.300	9.245	0.000	0.000	0.000	0.000	0.600	23.560	0.000	0.000	0.000	6.200

DEPARTURE/ARRIVAL CONDITIONS

Leg	Depart V Inf (km/s)	Depart Decl (deg)	Depart Rt Asc (deg)	Depart Brn Tm (min)	Depart Del V (km/s)	Depart VLoss (m/s)	Arrive V Inf (km/s)	Arrive Decl (deg)	Arrive Rt Asc (deg)	Arrive Brn Tm (min)	Arrive Del V (km/s)	Arrive VLoss (m/s)
1	3.11432	-8.92	168.66	12.741	0.92216	13.062	5.45214	-7.24	314.24	0.000	0.00000	0.000
2	2.79973	22.29	160.17	6.068	0.97502	2.970	6.81300	15.54	84.03	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.2574544	0.220382343	1.18160	283.77331	169.59606	10.48778	156.83292	0.9803336	1.5345751	515.03505
2	1.3029496	0.287871025	1.65105	107.77940	232.40002	194.26408	307.54150	0.9278682	1.6780311	543.23766

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
800.00000	51.60000	0.92216	-47.33333	116.49330	-0.27880	0.55935	-0.67807
800.00000	51.60000	0.92216	34.93604	127.89596	-0.46435	0.59657	0.52809

MISSION OPERATIONS

	Earth Dep	Helio	Mars Arr	Mars Dep	Helio	Earth Arr
Times (days)						
Depart/Arrive	0.00		198.30	727.25		917.25
Flight/Stay		198.30		528.95	190.00	
Esc/Cap Orbits (radii)						
Apoapse Distance	12.09		0.00	10.95		0.00
Periapse Distance	1.13		0.00	1.07		0.00
Spacecraft Distances (AU)						
Minimum Heliocentric		0.9833			1.0166	
Maximum Heliocentric		1.5004			1.6574	
Geocentric	0.0000		1.1247	1.6764		0.0000
Maneuvers						
Propulsion Type	Vloss		None	Vloss		None
Vinf (km/sec)	3.11		5.45	2.80		6.81
Eff Delta-V (km/sec)	0.92	0.00	0.00	0.98	0.00	0.00
Vel Losses (m/sec)	13.06		0.00	2.97		0.00
Propellant (kg or t)	18.52	0.00	0.00	9.25	0.00	0.00
Burn time (hr)	0.21		0.00	0.10		0.00
Thrust (lbs or klbs)	24.75		0.00	24.75		0.00
Spec Imp (sec)	463.4		0.0	442.1		0.0
Mass Changes (kg or t)						
Dry Stage Jettisoned	6.00		0.00	6.30		0.00
Probes Separated			17.31			23.56
AeroBrake Separated			13.10			0.00
Drop Mass Left			0.00			0.00
Sample Mass Added			0.00			0.00

[illegible] Fuel Boost Loaded Case

[illegible] (Converged)

PERFORMANCE SUMMARY

Leg	Stay Time (days)	Depart		Arrive		Flight Time (days)
1		Earth	JAN 6, 2014, 12.0000 hours GMT Julian Date 56664.0000	Mars	JUL 21, 2014, 21.6000 hours GMT Julian Date 56860.4000	196.4000
2	528.8542	Mars	JAN 1, 2016, 18.1004 hours GMT Julian Date 57389.2542	Earth	JUL 9, 2016, 18.1004 hours GMT Julian Date 57579.2542	190.0000
					Total Duration	915.2542

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Depart Engine	Depart Propell	Depart Tankage	Arrive Engine	Arrive Propell	Arrive Tankage	Inert	Probes	AeroBrk	Drops	Samples	NetMass
1	101.207	6.000	18.890	0.000	0.000	0.000	0.000	0.600	17.312	13.100	0.000	0.000	45.305
2	45.905	6.300	9.245	0.000	0.000	0.000	0.000	0.600	23.560	0.000	0.000	0.000	6.200

DEPARTURE/ARRIVAL CONDITIONS

Leg	Depart V Inf (km/s)	Depart Decl (deg)	Depart Rt Asc (deg)	Depart Brn Tm (min)	Depart Del V (km/s)	Depart VLoss (m/s)	Arrive V Inf (km/s)	Arrive Decl (deg)	Arrive Rt Asc (deg)	Arrive Brn Tm (min)	Arrive Del V (km/s)	Arrive VLoss (m/s)
1	3.16979	-7.60	167.66	12.995	0.93882	13.868	5.45048	-7.51	314.30	0.000	0.00000	0.000
2	2.79973	22.29	160.17	6.068	0.97502	2.970	6.81300	15.54	84.03	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.2566927	0.220917529	1.12652	285.80874	167.53580	12.55104	156.91190	0.9790672	1.5343181	514.56714
2	1.3029497	0.287871033	1.65105	107.77940	232.39999	194.26409	307.54151	0.9278682	1.6780312	543.23769

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
800.00000	51.60000	0.93882	-46.42066	117.32931	-0.29712	0.57494	-0.68010
800.00000	51.60000	0.93882	35.71852	126.84909	-0.45711	0.60994	0.54808

MISSION OPERATIONS

	Earth Dep	Helio	Mars Arr	Mars Dep	Helio	Earth Arr
Times (days)						
Depart/Arrive	0.00		196.40	725.25		915.25
Flight/Stay		196.40		528.85	190.00	
Esc/Cap Orbits (radii)						
Apoapse Distance	12.09		0.00	10.95		0.00
Periapse Distance	1.13		0.00	1.07		0.00
Spacecraft Distances (AU)						
Minimum Heliocentric		0.9833			1.0166	
Maximum Heliocentric		1.5002			1.6574	
Geocentric	0.0000		1.1253	1.6764		0.0000
Maneuvers						
Propulsion Type	Vloss		None	Vloss		None
Vinf (km/sec)	3.17		5.45	2.80		6.81
Eff Delta-V (km/sec)	0.94	0.00	0.00	0.98	0.00	0.00
Vel Losses (m/sec)	13.87		0.00	2.97		0.00
Propellant (kg or t)	18.89	0.00	0.00	9.25	0.00	0.00
Burn time (hr)	0.22		0.00	0.10		0.00
Thrust (lbs or klbs)	24.75		0.00	24.75		0.00
Spec Imp (sec)	463.4		0.0	442.1		0.0
Mass Changes (kg or t)						
Dry Stage Jettisoned	6.00		0.00	6.30		0.00
Probes Separated			17.31			23.56
AeroBrake Separated			13.10			0.00
Drop Mass Left			0.00			0.00
Sample Mass Added			0.00			0.00

Trajectory Name: Loaded Case

Leg 1 (Converged)

PERFORMANCE SUMMARY

Leg	Stay Time (days)	Depart		Arrive		Flight Time (days)
1		Earth	JAN 8, 2014, 12.0000 hours GMT Julian Date 56666.0000	Mars	JUL 22, 2014, 0.0000 hours GMT Julian Date 56860.5000	194.5000
2	528.7542	Mars	JAN 1, 2016, 18.0999 hours GMT Julian Date 57389.2542	Earth	JUL 9, 2016, 18.0999 hours GMT Julian Date 57579.2542	190.0000
					Total Duration	913.2542

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Depart Engine	Depart Propell	Depart Tankage	Arrive Engine	Arrive Propell	Arrive Tankage	Inert	Probes	AeroBrk	Drops	Samples	NetMass
1	101.664	6.000	19.347	0.000	0.000	0.000	0.000	0.600	17.312	13.100	0.000	0.000	45.305
2	45.905	6.300	9.245	0.000	0.000	0.000	0.000	0.600	23.560	0.000	0.000	0.000	6.200

DEPARTURE/ARRIVAL CONDITIONS

Leg	Depart V Inf (km/s)	Depart Decl (deg)	Depart Rt Asc (deg)	Depart Brn Tm (min)	Depart Del V (km/s)	Depart VLoss (m/s)	Arrive V Inf (km/s)	Arrive Decl (deg)	Arrive Rt Asc (deg)	Arrive Brn Tm (min)	Arrive Del V (km/s)	Arrive VLoss (m/s)
1	3.23659	-6.35	166.70	13.310	0.95928	14.908	5.44861	-7.77	314.32	0.000	0.00000	0.000
2	2.79973	22.29	160.17	6.068	0.97502	2.970	6.81300	15.54	84.03	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.2557727	0.221544971	1.07780	287.84439	165.44233	14.64717	157.02385	0.9775625	1.5339828	514.00218
2	1.3029497	0.287871042	1.65105	107.77941	232.39996	194.26409	307.54152	0.9278682	1.6780312	543.23771

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
800.00000	51.60000	0.95928	-45.44157	118.16170	-0.31766	0.59339	-0.68352
800.00000	51.60000	0.95928	36.36177	125.93619	-0.45337	0.62547	0.56874

MISSION OPERATIONS

	Earth Dep	Helio	Mars Arr	Mars Dep	Helio	Earth Arr
Times (days)						
Depart/Arrive	0.00		194.50	723.25		913.25
Flight/Stay		194.50		528.75	190.00	
Esc/Cap Orbits (radii)						
Apoapse Distance	12.09		0.00	10.95		0.00
Periapse Distance	1.13		0.00	1.07		0.00
Spacecraft Distances (AU)						
Minimum Heliocentric		0.9834			1.0166	
Maximum Heliocentric		1.5001			1.6574	
Geocentric	0.0000		1.1260	1.6764		0.0000
Maneuvers						
Propulsion Type	Vloss		None	Vloss		None
Vinf (km/sec)	3.24		5.45	2.80		6.81
Eff Delta-V (km/sec)	0.96	0.00	0.00	0.98	0.00	0.00
Vel Losses (m/sec)	14.91		0.00	2.97		0.00
Propellant (kg or t)	19.35	0.00	0.00	9.25	0.00	0.00
Burn time (hr)	0.22		0.00	0.10		0.00
Thrust (lbs or klbs)	24.75		0.00	24.75		0.00
Spec Imp (sec)	463.4		0.0	442.1		0.0
Mass Changes (kg or t)						
Dry Stage Jettisoned	6.00		0.00	6.30		0.00
Probes Separated			17.31			23.56
AeroBrake Separated			13.10			0.00
Drop Mass Left			0.00			0.00
Sample Mass Added			0.00			0.00

Fully Fueled Loaded Case

Case 1 (Converged)

PERFORMANCE SUMMARY

Leg	Stay Time (days)	Depart		Arrive		Flight Time (days)
1		Earth	JAN 10, 2014, 12.0000 hours GMT Julian Date 56668.0000	Mars	JUL 22, 2014, 2.4000 hours GMT Julian Date 56860.6000	192.6000
2	528.6541	Mars	JAN 1, 2016, 18.0994 hours GMT Julian Date 57389.2541	Earth	JUL 9, 2016, 18.0994 hours GMT Julian Date 57579.2541	190.0000
					Total Duration	911.2541

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Depart Engine	Depart Propell	Depart Tankage	Arrive Engine	Arrive Propell	Arrive Tankage	Inert	Probes	AeroBrk	Drops	Samples	NetMass
1	102.212	6.000	19.895	0.000	0.000	0.000	0.000	0.600	17.312	13.100	0.000	0.000	45.305
2	45.905	6.300	9.245	0.000	0.000	0.000	0.000	0.600	23.560	0.000	0.000	0.000	6.200

DEPARTURE/ARRIVAL CONDITIONS

Leg	Depart V Inf (km/s)	Depart Decl (deg)	Depart Rt Asc (deg)	Depart Brn Tm (min)	Depart Del V (km/s)	Depart VLoss (m/s)	Arrive V Inf (km/s)	Arrive Decl (deg)	Arrive Rt Asc (deg)	Arrive Brn Tm (min)	Arrive Del V (km/s)	Arrive VLoss (m/s)
1	3.31449	-5.19	165.79	13.687	0.98372	16.223	5.44649	-8.02	314.31	0.000	0.00000	0.000
2	2.79973	22.29	160.17	6.068	0.97502	2.970	6.81300	15.54	84.03	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.2546882	0.222271418	1.03452	289.88018	163.31543	16.77637	157.16907	0.9758068	1.5335695	513.33648
2	1.3029498	0.287871051	1.65105	107.77942	232.39993	194.26410	307.54152	0.9278682	1.6780313	543.23774

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
800.00000	51.60000	0.98372	-44.40399	118.99913	-0.34071	0.61468	-0.68832
800.00000	51.60000	0.98372	36.87292	125.17865	-0.45338	0.64322	0.59027

MISSION OPERATIONS

	Earth Dep	Helio	Mars Arr	Mars Dep	Helio	Earth Arr
Times (days)						
Depart/Arrive	0.00		192.60	721.25		911.25
Flight/Stay		192.60		528.65	190.00	
Esc/Cap Orbits (radii)						
Apoapse Distance	12.09		0.00	10.95		0.00
Periapse Distance	1.13		0.00	1.07		0.00
Spacecraft Distances (AU)						
Minimum Heliocentric		0.9834			1.0166	
Maximum Heliocentric		1.5000			1.6574	
Geocentric	0.0000		1.1266	1.6764		0.0000
Maneuvers						
Propulsion Type	Vloss		None	Vloss		None
Vinf (km/sec)	3.31		5.45	2.80		6.81
Eff Delta-V (km/sec)	0.98	0.00	0.00	0.98	0.00	0.00
Vel Losses (m/sec)	16.22		0.00	2.97		0.00
Propellant (kg or t)	19.89	0.00	0.00	9.25	0.00	0.00
Burn time (hr)	0.23		0.00	0.10		0.00
Thrust (lbs or klbs)	24.75		0.00	24.75		0.00
Spec Imp (sec)	463.4		0.0	442.1		0.0
Mass Changes (kg or t)						
Dry Stage Jettisoned	6.00		0.00	6.30		0.00
Probes Separated			17.31			23.56
AeroBrake Separated			13.10			0.00
Drop Mass Left			0.00			0.00
Sample Mass Added			0.00			0.00

File Name: Loaded Case

(Converged)

PERFORMANCE SUMMARY

Stay Time (days)	Depart		Arrive		Flight Time (days)
	Earth	JAN 12, 2014, 12.0000 hours GMT Julian Date 56670.0000	Mars	JUL 22, 2014, 2.4000 hours GMT Julian Date 56860.6000	190.6000
528.6541	Mars	JAN 1, 2016, 18.0990 hours GMT Julian Date 57389.2541	Earth	JUL 9, 2016, 18.0990 hours GMT Julian Date 57579.2541	190.0000
				Total Duration	909.2541

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Depart Engine	Depart Propell	Depart Tankage	Arrive Engine	Arrive Propell	Arrive Tankage	Inert	Probes	AeroBrk	Drops	Samples	NetMass
1	102.859	6.000	20.542	0.000	0.000	0.000	0.000	0.600	17.312	13.100	0.000	0.000	45.305
2	45.905	6.300	9.245	0.000	0.000	0.000	0.000	0.600	23.560	0.000	0.000	0.000	6.200

DEPARTURE/ARRIVAL CONDITIONS

Leg	Depart V Inf (km/s)	Depart Decl (deg)	Depart Rt Asc (deg)	Depart Brn Tm (min)	Depart Del V (km/s)	Depart VLoss (m/s)	Arrive V Inf (km/s)	Arrive Decl (deg)	Arrive Rt Asc (deg)	Arrive Brn Tm (min)	Arrive Del V (km/s)	Arrive VLoss (m/s)
1	3.40356	-4.10	164.99	14.132	1.01242	17.872	5.45055	-8.27	314.28	0.000	0.00000	0.000
2	2.79973	22.29	160.17	6.068	0.97502	2.970	6.81300	15.54	84.03	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.2536313	0.223211351	0.99241	291.91572	161.17844	18.91564	157.27082	0.9738065	1.5334560	512.68800
2	1.3029498	0.287871059	1.65105	107.77943	232.39990	194.26411	307.54153	0.9278683	1.6780313	543.23776

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
800.00000	51.60000	1.01242	-43.30342	119.91316	-0.36742	0.63862	-0.69438
800.00000	51.60000	1.01242	37.27075	124.63584	-0.45791	0.66289	0.61310

MISSION OPERATIONS

	Earth Dep	Helio	Mars Arr	Mars Dep	Helio	Earth Arr
Times (days)						
Depart/Arrive	0.00		190.60	719.25		909.25
Flight/Stay		190.60		528.65	190.00	
Esc/Cap Orbits (radii)						
Apoapse Distance	12.09		0.00	10.95		0.00
Periapse Distance	1.13		0.00	1.07		0.00
Spacecraft Distances (AU)						
Minimum Heliocentric		0.9835			1.0166	
Maximum Heliocentric		1.5000			1.6574	
Geocentric	0.0000		1.1266	1.6764		0.0000
Maneuvers						
Propulsion Type	Vloss		None	Vloss		None
Vinf (km/sec)	3.40		5.45	2.80		6.81
Eff Delta-V (km/sec)	1.01	0.00	0.00	0.98	0.00	0.00
Vel Losses (m/sec)	17.87		0.00	2.97		0.00
Propellant (kg or t)	20.54	0.00	0.00	9.25	0.00	0.00
Burn time (hr)	0.24		0.00	0.10		0.00
Thrust (lbs or klbs)	24.75		0.00	24.75		0.00
Spec Imp (sec)	463.4		0.0	442.1		0.0
Mass Changes (kg or t)						
Dry Stage Jettisoned	6.00		0.00	6.30		0.00
Probes Separated			17.31			23.56
AeroBrake Separated			13.10			0.00
Drop Mass Left			0.00			0.00
Sample Mass Added			0.00			0.00

File Name: Loaded Case

(Converged)

PERFORMANCE SUMMARY

Leg	Stay Time (days)	Depart		Arrive		Flight Time (days)
		Earth	JAN 13, 2014, 12.0000 hours GMT Julian Date 56671.0000	Mars	JUL 22, 2014, 2.4000 hours GMT Julian Date 56860.6000	189.6000
	528.6541	Mars	JAN 1, 2016, 18.0988 hours GMT Julian Date 57389.2541	Earth	JUL 9, 2016, 18.0988 hours GMT Julian Date 57579.2541	190.0000
					Total Duration	908.2541

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Depart Engine	Depart Propell	Depart Tankage	Arrive Engine	Arrive Propell	Arrive Tankage	Inert	Probes	AeroBrk	Drops	Samples	NetMass
1	103.222	6.000	20.904	0.000	0.000	0.000	0.000	0.600	17.312	13.100	0.000	0.000	45.305
2	45.905	6.300	9.245	0.000	0.000	0.000	0.000	0.600	23.560	0.000	0.000	0.000	6.200

DEPARTURE/ARRIVAL CONDITIONS

Leg	Depart V Inf (km/s)	Depart Decl (deg)	Depart Rt Asc (deg)	Depart Brn Tm (min)	Depart Del V (km/s)	Depart VLoss (m/s)	Arrive V Inf (km/s)	Arrive Decl (deg)	Arrive Rt Asc (deg)	Arrive Brn Tm (min)	Arrive Del V (km/s)	Arrive VLoss (m/s)
1	3.45207	-3.58	164.61	14.381	1.02839	18.842	5.45253	-8.40	314.25	0.000	0.00000	0.000
2	2.79974	22.29	160.17	6.068	0.97502	2.970	6.81300	15.54	84.03	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.2530376	0.223722760	0.97306	292.93350	160.09755	19.99753	157.33408	0.9727046	1.5333707	512.32388
2	1.3029498	0.287871064	1.65105	107.77943	232.39989	194.26411	307.54153	0.9278683	1.6780314	543.23778

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
800.00000	51.60000	1.02839	-42.73784	120.37302	-0.38191	0.65165	-0.69791
800.00000	51.60000	1.02839	37.42331	124.43079	-0.46178	0.67363	0.62495

MISSION OPERATIONS

	Earth Dep	Helio	Mars Arr	Mars Dep	Helio	Earth Arr
Times (days)						
Depart/Arrive	0.00		189.60	718.25		908.25
Flight/Stay		189.60	528.65		190.00	
Esc/Cap Orbits (radii)						
Apoapse Distance	12.09		0.00	10.95		0.00
Periapse Distance	1.13		0.00	1.07		0.00
Spacecraft Distances (AU)						
Minimum Heliocentric		0.9835			1.0166	
Maximum Heliocentric		1.5000			1.6574	
Geocentric	0.0000		1.1266	1.6764		0.0000
Maneuvers						
Propulsion Type	Vloss		None	Vloss		None
Vinf (km/sec)	3.45		5.45	2.80		6.81
Eff Delta-V (km/sec)	1.03	0.00	0.00	0.98	0.00	0.00
Vel Losses (m/sec)	18.84		0.00	2.97		0.00
Propellant (kg or t)	20.90	0.00	0.00	9.25	0.00	0.00
Burn time (hr)	0.24		0.00	0.10		0.00
Thrust (lbs or klbs)	24.75		0.00	24.75		0.00
Spec Imp (sec)	463.4		0.0	442.1		0.0
Mass Changes (kg or t)						
Dry Stage Jettisoned	6.00		0.00	6.30		0.00
Probes Separated			17.31			23.56
AeroBrake Separated			13.10			0.00
Drop Mass Left			0.00			0.00
Sample Mass Added			0.00			0.00

[illegible] Mars: Loaded Case

[illegible] (Converged)

PERFORMANCE SUMMARY

Leg	Stay Time (days)	Depart		Arrive		Flight Time (days)
1		Earth	JAN 14, 2014, 12.0000 hours GMT Julian Date 56672.0000	Mars	JUL 22, 2014, 4.8000 hours GMT Julian Date 56860.7000	188.7000
2	528.5541	Mars	JAN 1, 2016, 18.0985 hours GMT Julian Date 57389.2541	Earth	JUL 9, 2016, 18.0985 hours GMT Julian Date 57579.2541	190.0000
					Total Duration	907.2541

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Depart Engine	Depart Propell	Depart Tankage	Arrive Engine	Arrive Propell	Arrive Tankage	Inert	Probes	AeroBrk	Drops	Samples	NetMass
1	103.608	6.000	21.291	0.000	0.000	0.000	0.000	0.600	17.312	13.100	0.000	0.000	45.305
2	45.905	6.300	9.245	0.000	0.000	0.000	0.000	0.600	23.560	0.000	0.000	0.000	6.200

DEPARTURE/ARRIVAL CONDITIONS

Leg	Depart V Inf (km/s)	Depart Decl (deg)	Depart Rt Asc (deg)	Depart Brn Tm (min)	Depart Del V (km/s)	Depart VLoss (m/s)	Arrive V Inf (km/s)	Arrive Decl (deg)	Arrive Rt Asc (deg)	Arrive Brn Tm (min)	Arrive Del V (km/s)	Arrive VLoss (m/s)
1	3.50288	-3.10	164.21	14.648	1.04539	19.915	5.44795	-8.51	314.20	0.000	0.00000	0.000
2	2.79974	22.29	160.17	6.068	0.97502	2.970	6.81300	15.54	84.03	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.2521998	0.224156824	0.95804	293.95159	158.98470	21.11096	157.48277	0.9715107	1.5328889	511.81011
2	1.3029498	0.287871068	1.65105	107.77944	232.39987	194.26411	307.54154	0.9278683	1.6780314	543.23779

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
800.00000	51.60000	1.04539	-42.17536	120.77749	-0.39643	0.66562	-0.70188
800.00000	51.60000	1.04539	37.53574	124.22976	-0.46630	0.68538	0.63691

MISSION OPERATIONS

	Earth Dep	Helio	Mars Arr	Mars Dep	Helio	Earth Arr
Times (days)						
Depart/Arrive	0.00		188.70	717.25		907.25
Flight/Stay		188.70		528.55	190.00	
Esc/Cap Orbits (radii)						
Apoapse Distance	12.09		0.00	10.95		0.00
Periapse Distance	1.13		0.00	1.07		0.00
Spacecraft Distances (AU)						
Minimum Heliocentric		0.9836			1.0166	
Maximum Heliocentric		1.4999			1.6574	
Geocentric	0.0000		1.1273	1.6764		0.0000
Maneuvers						
Propulsion Type	Vloss		None	Vloss		None
Vinf (km/sec)	3.50		5.45	2.80		6.81
Eff Delta-V (km/sec)	1.05	0.00	0.00	0.98	0.00	0.00
Vel Losses (m/sec)	19.91		0.00	2.97		0.00
Propellant (kg or t)	21.29	0.00	0.00	9.25	0.00	0.00
Burn time (hr)	0.24		0.00	0.10		0.00
Thrust (lbs or klbs)	24.75		0.00	24.75		0.00
Spec Imp (sec)	463.4		0.0	442.1		0.0
Mass Changes (kg or t)						
Dry Stage Jettisoned	6.00		0.00	6.30		0.00
Probes Separated			17.31			23.56
AeroBrake Separated			13.10			0.00
Drop Mass Left			0.00			0.00
Sample Mass Added			0.00			0.00

File Name: Loaded Case

(Converged)

PERFORMANCE SUMMARY

Leg	Dep. Time (days)	Depart		Arrive		Flight Time (days)
1		Earth	JAN 16, 2014, 12.0000 hours GMT Julian Date 56674.0000	Mars	JUL 22, 2014, 7.2000 hours GMT Julian Date 56860.8000	186.8000
2	528.4541	Mars	JAN 1, 2016, 18.0981 hours GMT Julian Date 57389.2541	Earth	JUL 9, 2016, 18.0981 hours GMT Julian Date 57579.2541	190.0000
					Total Duration	905.2541

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Depart Engine	Depart Propell	Depart Tankage	Arrive Engine	Arrive Propell	Arrive Tankage	Inert	Probes	AeroBrk	Drops	Samples	NetMass
1	104.469	6.000	22.152	0.000	0.000	0.000	0.000	0.600	17.312	13.100	0.000	0.000	45.305
2	45.905	6.300	9.245	0.000	0.000	0.000	0.000	0.600	23.560	0.000	0.000	0.000	6.200

DEPARTURE/ARRIVAL CONDITIONS

Leg	Depart V Inf (km/s)	Depart Decl (deg)	Depart Rt Asc (deg)	Depart Brn Tm (min)	Depart Del V (km/s)	Depart VLoss (m/s)	Arrive V Inf (km/s)	Arrive Decl (deg)	Arrive Rt Asc (deg)	Arrive Brn Tm (min)	Arrive Del V (km/s)	Arrive VLoss (m/s)
1	3.61254	-2.19	163.51	15.240	1.08299	22.447	5.44513	-8.74	314.08	0.000	0.00000	0.000
2	2.79974	22.29	160.17	6.068	0.97502	2.970	6.81300	15.54	84.03	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.2505849	0.225224555	0.92720	295.98738	156.75754	23.33931	157.72821	0.9689225	1.5322473	510.82037
2	1.3029499	0.287871077	1.65105	107.77944	232.39984	194.26412	307.54154	0.9278683	1.6780315	543.23781

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
800.00000	51.60000	1.08299	-41.01428	121.66776	-0.42901	0.69550	-0.71071
800.00000	51.60000	1.08299	37.68813	124.01133	-0.47938	0.71041	0.66210

MISSION OPERATIONS

	Earth Dep	Helio	Mars Arr	Mars Dep	Helio	Earth Arr
Times (days)						
Depart/Arrive	0.00		186.80	715.25		905.25
Flight/Stay		186.80		528.45	190.00	
Esc/Cap Orbits (radii)						
Apoapse Distance	12.09		0.00	10.95		0.00
Periapse Distance	1.13		0.00	1.07		0.00
Spacecraft Distances (AU)						
Minimum Heliocentric		0.9837			1.0166	
Maximum Heliocentric		1.4997			1.6574	
Geocentric	0.0000		1.1279	1.6764		0.0000
Maneuvers						
Propulsion Type	Vloss		None	Vloss		None
Vinf (km/sec)	3.61		5.45	2.80		6.81
Eff Delta-V (km/sec)	1.08	0.00	0.00	0.98	0.00	0.00
Vel Losses (m/sec)	22.45		0.00	2.97		0.00
Propellant (kg or t)	22.15	0.00	0.00	9.25	0.00	0.00
Burn time (hr)	0.25		0.00	0.10		0.00
Thrust (lbs or klbs)	24.75		0.00	24.75		0.00
Spec Imp (sec)	463.4		0.0	442.1		0.0
Mass Changes (kg or t)						
Dry Stage Jettisoned	6.00		0.00	6.30		0.00
Probes Separated			17.31			23.56
AeroBrake Separated			13.10			0.00
Drop Mass Left			0.00			0.00
Sample Mass Added			0.00			0.00

File Name: Loaded Case

(Converged)

PERFORMANCE SUMMARY

Stay Time (days)	Depart		Arrive		Flight Time (days)
	Earth	JAN 18, 2014, 12.0000 hours GMT Julian Date 56676.0000	Mars	JUL 22, 2014, 7.2000 hours GMT Julian Date 56860.8000	184.8000
528.4541	Mars	JAN 1, 2016, 18.0976 hours GMT Julian Date 57389.2541	Earth	JUL 9, 2016, 18.0976 hours GMT Julian Date 57579.2541	190.0000
				Total Duration	903.2541

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Depart Engine	Depart Propell	Depart Tankage	Arrive Engine	Arrive Propell	Arrive Tankage	Inert	Probes	AeroBrk	Drops	Samples	NetMass
1	105.454	6.000	23.137	0.000	0.000	0.000	0.000	0.600	17.312	13.100	0.000	0.000	45.305
2	45.905	6.300	9.245	0.000	0.000	0.000	0.000	0.600	23.560	0.000	0.000	0.000	6.200

DEPARTURE/ARRIVAL CONDITIONS

Leg	Depart V Inf (km/s)	Depart Decl (deg)	Depart Rt Asc (deg)	Depart Brn Tm (min)	Depart Del V (km/s)	Depart VLoss (m/s)	Arrive V Inf (km/s)	Arrive Decl (deg)	Arrive Rt Asc (deg)	Arrive Brn Tm (min)	Arrive Del V (km/s)	Arrive VLoss (m/s)
1	3.73250	-1.35	162.93	15.917	1.12562	25.594	5.44872	-8.99	313.94	0.000	0.00000	0.000
2	2.79974	22.29	160.17	6.068	0.97502	2.970	6.81300	15.54	84.03	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.2489807	0.226526814	0.89649	298.02269	154.52121	25.57676	157.92946	0.9660531	1.5319084	509.83781
2	1.3029499	0.287871085	1.65105	107.77945	232.39982	194.26412	307.54155	0.9278683	1.6780315	543.23784

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
800.00000	51.60000	1.12562	-39.81821	122.63855	-0.46629	0.72804	-0.72079
800.00000	51.60000	1.12562	37.74185	124.01881	-0.49799	0.73777	0.68900

$\hat{\Delta V}$

-.[illegible]

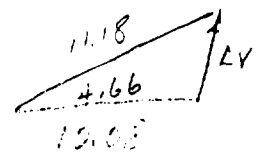
.64[illegible]

-.64032

1,1000 NO G-LOSSES

$\hat{W}_{18} \cdot \hat{W}_{25} = .996694$

WEDGE $\Delta\nu = 4.66°$



$\Delta V^2 = 226.5988 - 2[illegible].6437$

$\Delta V = 1398$ m/SEC

MISSION OPERATIONS

	Earth Dep	Earth Helio	Mars Arr	Mars Dep	Mars Helio	Earth Arr
Times (days)						
Depart/Arrive	0.00		184.80	713.25		903.25
Flight/Stay		184.80	528.45		190.00	
Hyp/Cap Orbits (radii)						
Apoapse Distance	12.09		0.00	10.95		0.00
Periapse Distance	1.13		0.00	1.07		0.00
Spacecraft Distances (AU)						
Minimum Heliocentric		0.9839			1.0166	
Maximum Heliocentric		1.4997			1.6574	
Geocentric	0.0000		1.1279	1.6764		0.0000
Maneuvers						
Propulsion Type	Vloss		None	Vloss		None
Vinf (km/sec)	3.73		5.45	2.80		6.81
Eff Delta-V (km/sec)	1.13	0.00	0.00	0.98	0.00	0.00
Vel Losses (m/sec)	25.59		0.00	2.97		0.00
Propellant (kg or t)	23.14	0.00	0.00	9.25	0.00	0.00
Burn time (hr)	0.27		0.00	0.10		0.00
Thrust (lbs or klbs)	24.75		0.00	24.75		0.00
Spec Imp (sec)	463.4		0.0	442.1		0.0
Mass Changes (kg or t)						
Dry Stage Jettisoned	6.00		0.00	6.30		0.00
Probes Separated			17.31			23.56
AeroBrake Separated			13.10			0.00
Drop Mass Left			0.00			0.00
Sample Mass Added			0.00			0.00

File Name: Loaded Case

(Converged)

PERFORMANCE SUMMARY

Stay Time (days)	Depart		Arrive		Flight Time (days)
	Earth	JAN 20, 2014, 12.0000 hours GMT Julian Date 56678.0000	Mars	JUL 22, 2014, 9.6000 hours GMT Julian Date 56860.9000	182.9000
528.3540	Mars	JAN 1, 2016, 18.0971 hours GMT Julian Date 57389.2540	Earth	JUL 9, 2016, 18.0971 hours GMT Julian Date 57579.2540	190.0000
				Total Duration	901.2540

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Depart Engine	Depart Propell	Depart Tankage	Arrive Engine	Arrive Propell	Arrive Tankage	Inert	Probes	AeroBrk	Drops	Samples	NetMass
1	106.569	6.000	24.251	0.000	0.000	0.000	0.000	0.600	17.312	13.100	0.000	0.000	45.305
2	45.905	6.300	9.245	0.000	0.000	0.000	0.000	0.600	23.560	0.000	0.000	0.000	6.200

DEPARTURE/ARRIVAL CONDITIONS

Leg	Depart V Inf (km/s)	Depart Decl (deg)	Depart Rt Asc (deg)	Depart Brn Tm (min)	Depart Del V (km/s)	Depart VLoss (m/s)	Arrive V Inf (km/s)	Arrive Decl (deg)	Arrive Rt Asc (deg)	Arrive Brn Tm (min)	Arrive Del V (km/s)	Arrive VLoss (m/s)
1	3.86198	-0.59	162.40	16.684	1.17341	29.494	5.44568	-9.22	313.76	0.000	0.00000	0.000
2	2.79974	22.29	160.17	6.068	0.97502	2.970	6.81300	15.54	84.03	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.2469806	0.227864616	0.87164	300.05809	152.22833	27.87007	158.24099	0.9628379	1.5311234	508.61362
2	1.3029500	0.287871094	1.65105	107.77946	232.39979	194.26413	307.54156	0.9278683	1.6780316	543.23786

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
800.00000	51.60000	1.17341	-38.61558	123.59062	-0.50725	0.76374	-0.73231
800.00000	51.60000	1.17341	37.68590	124.17185	-0.52158	0.76829	0.71734

1143.9 No G-LOSSES

MISSION OPERATIONS

	Earth Dep	Earth Helio	Mars Arr	Mars Dep	Mars Helio	Earth Arr
Times (days)						
Depart/Arrive	0.00		182.90	711.25		901.25
Flight/Stay		182.90	528.35		190.00	
Esc/Cap Orbits (radii)						
Apoapse Distance	12.09		0.00	10.95		0.00
Periapse Distance	1.13		0.00	1.07		0.00
Spacecraft Distances (AU)						
Minimum Heliocentric		0.9840			1.0166	
Maximum Heliocentric		1.4996			1.6574	
Geocentric	0.0000		1.1286	1.6764		0.0000
Maneuvers						
Propulsion Type	Vloss		None	Vloss		None
Vinf (km/sec)	3.86		5.45	2.80		6.81
Eff Delta-V (km/sec)	1.17	0.00	0.00	0.98	0.00	0.00
Vel Losses (m/sec)	29.49		0.00	2.97		0.00
Propellant (kg or t)	24.25	0.00	0.00	9.25	0.00	0.00
Burn time (hr)	0.28		0.00	0.10		0.00
Thrust (lbs or klbs)	24.75		0.00	24.75		0.00
Spec Imp (sec)	463.4		0.0	442.1		0.0
Mass Changes (kg or t)						
Dry Stage Jettisoned	6.00		0.00	6.30		0.00
Probes Separated			17.31			23.56
AeroBrake Separated			13.10			0.00
Drop Mass Left			0.00			0.00
Sample Mass Added			0.00			0.00

$V_p = 11.2339$

2.70

PERFORMANCE SUMMARY

Stay Time (days)	Depart		Arrive		Flight Time (days)
	Earth	JAN 21, 2014, 12.0000 hours GMT Julian Date 56679.0000	Mars	JUL 22, 2014, 9.6000 hours GMT Julian Date 56860.9000	181.9000
528.3540	Mars	JAN 1, 2016, 18.0969 hours GMT Julian Date 57389.2540	Earth	JUL 9, 2016, 18.0969 hours GMT Julian Date 57579.2540	190.0000
				Total Duration	900.2540

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Depart Engine	Depart Propell	Depart Tankage	Arrive Engine	Arrive Propell	Arrive Tankage	Inert	Probes	AeroBrk	Drops	Samples	NetMass
1	107.181	6.000	24.864	0.000	0.000	0.000	0.000	0.600	17.312	13.100	0.000	0.000	45.305
2	45.905	6.300	9.245	0.000	0.000	0.000	0.000	0.600	23.560	0.000	0.000	0.000	6.200

DEPARTURE/ARRIVAL CONDITIONS

Leg	Depart V Inf (km/s)	Depart Decl (deg)	Depart Rt Asc (deg)	Depart Brn Tm (min)	Depart Del V (km/s)	Depart VLoss (m/s)	Arrive V Inf (km/s)	Arrive Decl (deg)	Arrive Rt Asc (deg)	Arrive Brn Tm (min)	Arrive Del V (km/s)	Arrive VLoss (m/s)
1	3.93042	-0.24	162.18	17.105	1.19944	31.793	5.44747	-9.34	313.66	0.000	0.00000	0.000
2	2.79974	22.29	160.17	6.068	0.97502	2.970	6.81300	15.54	84.03	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.2460055	0.228639907	0.85877	301.07552	151.08183	29.01679	158.37017	0.9611189	1.5308921	508.01713
2	1.3029500	0.287871098	1.65105	107.77946	232.39977	194.26413	307.54156	0.9278683	1.6780316	543.23789

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
800.00000	51.60000	1.19944	-38.00544	124.10285	-0.52990	0.78258	-0.73854
800.00000	51.60000	1.19944	37.62524	124.33308	-0.53579	0.78447	0.73225

1167.64 NO S-LOSSES

$C_3 = 15.445201$

$\theta = 1.27919$

$\nu_h = 141.48°$

$R_M = 162.18$

1.33

$\Delta V_{21} = \Delta V_{23} = .999033$

WEDGE L = 2.52°

$\Delta V^2 = 228.1158$

$\Delta V = 1.255$ KM/SEC

MISSION OPERATIONS

	Earth Dep	Helio	Mars Arr	Mars Dep	Helio	Earth Arr
Times (days)						
Depart/Arrive	0.00		181.90	710.25		900.25
Flight/Stay		181.90		528.35	190.00	
Esc/Cap Orbits (radii)						
Apoapse Distance	12.09		0.00	10.95		0.00
Periapse Distance	1.13		0.00	1.07		0.00
Spacecraft Distances (AU)						
Minimum Heliocentric		0.9841			1.0166	
Maximum Heliocentric		1.4996			1.6574	
Geocentric	0.0000		1.1286	1.6764		0.0000
Maneuvers						
Propulsion Type	Vloss		None	Vloss		None
Vinf (km/sec)	3.93		5.45	2.80		6.81
Eff Delta-V (km/sec)	1.20	0.00	0.00	0.98	0.00	0.00
Vel Losses (m/sec)	31.79		0.00	2.97		0.00
Propellant (kg or t)	24.86	0.00	0.00	9.25	0.00	0.00
Burn time (hr)	0.29		0.00	0.10		0.00
Thrust (lbs or klbs)	24.75		0.00	24.75		0.00
Spec Imp (sec)	463.4		0.0	442.1		0.0
Mass Changes (kg or t)						
Dry Stage Jettisoned	6.00		0.00	6.30		0.00
Probes Separated			17.31			23.56
AeroBrake Separated			13.10			0.00
Drop Mass Left			0.00			0.00
Sample Mass Added			0.00			0.00

Plan Name: Loaded Case

(Converged)

PERFORMANCE SUMMARY

Stay Time (days)	Depart		Arrive		Flight Time (days)
	Earth	JAN 22, 2014, 12.0000 hours GMT Julian Date 56680.0000	Mars	JUL 22, 2014, 12.0000 hours GMT Julian Date 56861.0000	181.0000
528.2540	Mars	JAN 1, 2016, 18.0967 hours GMT Julian Date 57389.2540	Earth	JUL 9, 2016, 18.0967 hours GMT Julian Date 57579.2540	190.0000
				Total Duration	899.2540

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Depart Engine	Depart Propell	Depart Tankage	Arrive Engine	Arrive Propell	Arrive Tankage	Inert	Probes	AeroBrk	Drops	Samples	NetMass
1	107.829	6.000	25.512	0.000	0.000	0.000	0.000	0.600	17.312	13.100	0.000	0.000	45.305
2	45.905	6.300	9.245	0.000	0.000	0.000	0.000	0.600	23.560	0.000	0.000	0.000	6.200

DEPARTURE/ARRIVAL CONDITIONS

Leg	Depart V Inf (km/s)	Depart Decl (deg)	Depart Rt Asc (deg)	Depart Brn Tm (min)	Depart Del V (km/s)	Depart VLoss (m/s)	Arrive V Inf (km/s)	Arrive Decl (deg)	Arrive Rt Asc (deg)	Arrive Brn Tm (min)	Arrive Del V (km/s)	Arrive VLoss (m/s)
1	4.00097	0.08	161.95	17.551	1.22685	34.354	5.44266	-9.45	313.53	0.000	0.00000	0.000
2	2.79974	22.30	160.17	6.068	0.97502	2.970	6.81300	15.54	84.03	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.2447786	0.229352802	0.84924	302.09318	149.90336	30.19507	158.58491	0.9592851	1.5302720	507.26698
2	1.3029500	0.287871103	1.65105	107.77947	232.39976	194.26414	307.54156	0.9278683	1.6780317	543.23789

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
800.00000	51.60000	1.22685	-37.40238	124.58070	-0.55315	0.80241	-0.74520
800.00000	51.60000	1.22685	37.53501	124.50295	-0.55108	0.80174	0.74745

MISSION OPERATIONS

	Earth Dep	Helio	Mars Arr	Mars Dep	Helio	Earth Arr
Times (days)						
Depart/Arrive	0.00		181.00	709.25		899.25
Flight/Stay		181.00	528.25		190.00	
Esc/Cap Orbits (radii)						
Apoapse Distance	12.09		0.00	10.95		0.00
Periapse Distance	1.13		0.00	1.07		0.00
Spacecraft Distances (AU)						
Minimum Heliocentric		0.9842			1.0166	
Maximum Heliocentric		1.4995			1.6574	
Geocentric	0.0000		1.1292	1.6764		0.0000
Maneuvers						
Propulsion Type	Vloss		None	Vloss		None
Vinf (km/sec)	4.00		5.44	2.80		6.81
Eff Delta-V (km/sec)	1.23	0.00	0.00	0.98	0.00	0.00
Vel Losses (m/sec)	34.35		0.00	2.97		0.00
Propellant (kg or t)	25.51	0.00	0.00	9.25	0.00	0.00
Burn time (hr)	0.29		0.00	0.10		0.00
Thrust (lbs or klbs)	24.75		0.00	24.75		0.00
Spec Imp (sec)	463.4		0.0	442.1		0.0
Mass Changes (kg or t)						
Dry Stage Jettisoned	6.00		0.00	6.30		0.00
Probes Separated			17.31			23.56
AeroBrake Separated			13.10			0.00
Drop Mass Left			0.00			0.00
Sample Mass Added			0.00			0.00

$\Delta V^2 = 225.6(4 - 2[illegible]$

$\Delta V = 1240$ m/SEC

Mars Loaded Case

(Converged)

PERFORMANCE SUMMARY

Stay Time (days)	Depart		Arrive		Flight Time (days)
	Earth	JAN 23, 2014, 12.0000 hours GMT Julian Date 56681.0000	Mars	JUL 22, 2014, 12.0000 hours GMT Julian Date 56861.0000	180.0000
528.2540	Mars	JAN 1, 2016, 18.0964 hours GMT Julian Date 57389.2540	Earth	JUL 9, 2016, 18.0964 hours GMT Julian Date 57579.2540	190.0000
				Total Duration	898.2540

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Depart Engine	Depart Propell	Depart Tankage	Arrive Engine	Arrive Propell	Arrive Tankage	Inert	Probes	AeroBrk	Drops	Samples	NetMass
1	108.520	6.000	26.203	0.000	0.000	0.000	0.000	0.600	17.312	13.100	0.000	0.000	45.305
2	45.905	6.300	9.245	0.000	0.000	0.000	0.000	0.600	23.560	0.000	0.000	0.000	6.200

DEPARTURE/ARRIVAL CONDITIONS

Leg	Depart V Inf (km/s)	Depart Decl (deg)	Depart Rt Asc (deg)	Depart Brn Tm (min)	Depart Del V (km/s)	Depart VLoss (m/s)	Arrive V Inf (km/s)	Arrive Decl (deg)	Arrive Rt Asc (deg)	Arrive Brn Tm (min)	Arrive Del V (km/s)	Arrive VLoss (m/s)
1	4.07408	0.40	161.78	18.027	1.25588	37.229	5.44450	-9.57	313.42	0.000	0.00000	0.000
2	2.79974	22.30	160.17	6.068	0.97502	2.970	6.81300	15.54	84.03	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.2437000	0.230206342	0.83755	303.11043	148.74108	31.35737	158.73004	0.9573924	1.5300077	506.60782
2	1.3029500	0.287871107	1.65105	107.77947	232.39974	194.26414	307.54157	0.9278684	1.6780317	543.23790

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
800.00000	51.60000	1.25588	-36.78965	125.11103	-0.57847	0.82275	-0.75212
800.00000	51.60000	1.25588	37.42859	124.74879	-0.56844	0.81945	0.76329

1.21865 Mo-5 10555 5

MISSION OPERATIONS

	Earth Dep	Helio	Mars Arr	Mars Dep	Helio	Earth Arr
Times (days)						
Depart/Arrive	0.00		180.00	708.25		898.25
Flight/Stay		180.00	528.25		190.00	
Esc/Cap Orbits (radii)						
Apoapse Distance	12.09		0.00	10.95		0.00
Periapse Distance	1.13		0.00	1.07		0.00
Spacecraft Distances (AU)						
Minimum Heliocentric		0.9843			1.0166	
Maximum Heliocentric		1.4995			1.6574	
Geocentric	0.0000		1.1292	1.6764		0.0000
Maneuvers						
Propulsion Type	Vloss		None	Vloss		None
Vinf (km/sec)	4.07		5.44	2.80		6.81
Eff Delta-V (km/sec)	1.26	0.00	0.00	0.98	0.00	0.00
Vel Losses (m/sec)	37.23		0.00	2.97		0.00
Propellant (kg or t)	26.20	0.00	0.00	9.25	0.00	0.00
Burn time (hr)	0.30		0.00	0.10		0.00
Thrust (lbs or klbs)	24.75		0.00	24.75		0.00
Spec Imp (sec)	463.4		0.0	442.1		0.0
Mass Changes (kg or t)						
Dry Stage Jettisoned	6.00		0.00	6.30		0.00
Probes Separated			17.31			23.56
AeroBrake Separated			13.10			0.00
Drop Mass Left			0.00			0.00
Sample Mass Added			0.00			0.00

$\Delta V_{22} \cdot \Delta V_{25} = .99981$

WEDGE V = 1.113°

$\Delta V^2 = 229.265 - 227.7375$

$\Delta V = 1.236$

Converged

PERFORMANCE SUMMARY

Stay Time (days)	Depart		Arrive		Flight Time (days)
	Earth	JAN 24, 2014, 12.0000 hours GMT Julian Date 56682.0000	Mars	JUL 23, 2014, 12.0000 hours GMT Julian Date 56862.0000	180.0000
507.2540	Mars	JAN 1, 2016, 18.0962 hours GMT Julian Date 57389.2540	Earth	JUL 9, 2016, 18.0962 hours GMT Julian Date 57579.2540	190.0000
				Total Duration	897.2540

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Depart Engine	Depart Propell	Depart Tankage	Arrive Engine	Arrive Propell	Arrive Tankage	Inert	Probes	AeroBrk	Drops	Samples	NetMass
1	109.230	6.000	26.913	0.000	0.000	0.000	0.000	0.600	17.312	13.100	0.000	0.000	45.305
2	45.905	6.300	9.245	0.000	0.000	0.000	0.000	0.600	23.560	0.000	0.000	0.000	6.200

DEPARTURE/ARRIVAL CONDITIONS

Leg	Depart V Inf (km/s)	Depart Decl (deg)	Depart Rt Asc (deg)	Depart Brn Tm (min)	Depart Del V (km/s)	Depart VLoss (m/s)	Arrive V Inf (km/s)	Arrive Decl (deg)	Arrive Rt Asc (deg)	Arrive Brn Tm (min)	Arrive Del V (km/s)	Arrive VLoss (m/s)
1	4.14704	0.61	161.29	18.515	1.28550	40.342	5.38052	-9.57	313.13	0.000	0.00000	0.000
2	2.79974	22.30	160.17	6.068	0.97502	2.970	6.81300	15.54	84.03	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.2405997	0.230126899	0.85250	304.13058	147.33440	32.76097	159.65548	0.9551043	1.5260951	504.71468
2	1.3029500	0.287871111	1.65105	107.77947	232.39973	194.26414	307.54157	0.9278684	1.6780317	543.23791

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
800.00000	51.60000	1.28550	-36.25913	125.25832	-0.59837	0.84642	-0.76030
800.00000	51.60000	1.28550	37.24309	124.71857	-0.58285	0.84116	0.77798

1245 NO G-LOSSES

MISSION OPERATIONS

	Earth Dep	Earth Helio	Mars Arr	Mars Dep	Mars Helio	Earth Arr
Times (days)						
Depart/Arrive	0.00		180.00	707.25		897.25
Flight/Stay		180.00	527.25		190.00	
Esc/Cap Orbits (radii)						
Apoapse Distance	12.09		0.00	10.95		0.00
Periapse Distance	1.13		0.00	1.07		0.00
Spacecraft Distances (AU)						
Minimum Heliocentric		0.9844			1.0166	
Maximum Heliocentric		1.4982			1.6574	
Geocentric	0.0000		1.1356	1.6764		0.0000
Maneuvers						
Propulsion Type	Vloss		None	Vloss		None
Vinf (km/sec)	4.15		5.38	2.80		6.81
Eff Delta-V (km/sec)	1.29	0.00	0.00	0.98	0.00	0.00
Vel Losses (m/sec)	40.34		0.00	2.97		0.00
Propellant (kg or t)	26.91	0.00	0.00	9.25	0.00	0.00
Burn time (hr)	0.31		0.00	0.10		0.00
Thrust (lbs or klbs)	24.75		0.00	24.75		0.00
Spec Imp (sec)	463.4		0.0	442.1		0.0
Mass Changes (kg or t)						
Dry Stage Jettisoned	6.00		0.00	6.30		0.00
Probes Separated			17.31			23.56
AeroBrake Separated			13.10			0.00
Drop Mass Left			0.00			0.00
Sample Mass Added			0.00			0.00

$\hat{\Delta V}_{2N} \cdot \hat{\Delta V}_{2S} = .999955$

WEDGE ANGLE = 0.5°

$\Delta V^2 = 229.562 - 225.32$

$\Delta V = 1249$

Loaded Case

(Converged)

PERFORMANCE SUMMARY

Stay Time (days)	Depart		Arrive		Flight Time (days)
	Earth	JAN 25, 2014, 12.0000 hours GMT Julian Date 56683.0000	Mars	JUL 24, 2014, 12.0000 hours GMT Julian Date 56863.0000	180.0000
526.2540	Mars	JAN 1, 2016, 18.0960 hours GMT Julian Date 57389.2540	Earth	JUL 9, 2016, 18.0960 hours GMT Julian Date 57579.2540	190.0000
				Total Duration	896.2540

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Depart Engine	Depart Propell	Depart Tankage	Arrive Engine	Arrive Propell	Arrive Tankage	Inert	Probes	AeroBrk	Drops	Samples	NetMass
1	109.984	6.000	27.667	0.000	0.000	0.000	0.000	0.600	17.312	13.100	0.000	0.000	45.305
2	45.905	6.300	9.245	0.000	0.000	0.000	0.000	0.600	23.560	0.000	0.000	0.000	6.200

DEPARTURE/ARRIVAL CONDITIONS

Leg	Depart V Inf (km/s)	Depart Decl (deg)	Depart Rt Asc (deg)	Depart Brn Tm (min)	Depart Del V (km/s)	Depart VLoss (m/s)	Arrive V Inf (km/s)	Arrive Decl (deg)	Arrive Rt Asc (deg)	Arrive Brn Tm (min)	Arrive Del V (km/s)	Arrive VLoss (m/s)
1	4.22230	0.81	160.85	19.034	1.31677	43.831	5.31761	-9.57	312.82	0.000	0.00000	0.000
2	2.79974	22.30	160.17	6.068	0.97502	2.970	6.81300	15.54	84.03	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.2375134	0.230134897	0.86730	305.15042	145.92744	34.16494	160.58244	0.9527183	1.5223084	502.83242
2	1.3029501	0.287871116	1.65105	107.77948	232.39971	194.26415	307.54157	0.9278684	1.6780318	543.23793

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
800.00000	51.60000	1.31677	-35.72819	125.44790	-0.61995	0.87081	-0.76892
800.00000	51.60000	1.31677	37.03756	124.75348	-0.59918	0.86360	0.79314

1.2129 NO G-LOSSES

MISSION OPERATIONS

	Earth Dep	Earth Helio	Mars Arr	Mars Dep	Mars Helio	Earth Arr
Times (days)						
Depart/Arrive	0.00		180.00	706.25		896.25
Flight/Stay		180.00	526.25		190.00	
Esc/Cap Orbits (radii)						
Apoapse Distance	12.09		0.00	10.95		0.00
Periapse Distance	1.13		0.00	1.07		0.00
Spacecraft Distances (AU)						
Minimum Heliocentric		0.9845			1.0166	
Maximum Heliocentric		1.4969			1.6574	
Geocentric	0.0000		1.1420	1.6764		0.0000
Maneuvers						
Propulsion Type	Vloss		None	Vloss		None
Vinf (km/sec)	4.22		5.32	2.80		6.81
Eff Delta-V (km/sec)	1.32	0.00	0.00	0.98	0.00	0.00
Vel Losses (m/sec)	43.83		0.00	2.97		0.00
Propellant (kg or t)	27.67	0.00	0.00	9.25	0.00	0.00
Burn time (hr)	0.32		0.00	0.10		0.00
Thrust (lbs or klbs)	24.75		0.00	24.75		0.00
Spec Imp (sec)	463.4		0.0	442.1		0.0
Mass Changes (kg or t)						
Dry Stage Jettisoned	6.00		0.00	6.30		0.00
Probes Separated			17.31			23.56
AeroBrake Separated			13.10			0.00
Drop Mass Left			0.00			0.00
Sample Mass Added			0.00			0.00

[illegible] Guarded Case

[illegible] Converged)

PERFORMANCE SUMMARY

Leg	Stay Time (days)	Depart		Arrive		Flight Time (days)
1		Earth	JAN 26, 2014, 12.0000 hours GMT Julian Date 56684.0000	Mars	JUL 29, 2014, 12.0000 hours GMT Julian Date 56868.0000	184.0000
2	521.2540	Mars	JAN 1, 2016, 18.0957 hours GMT Julian Date 57389.2540	Earth	JUL 9, 2016, 18.0957 hours GMT Julian Date 57579.2540	190.0000
					Total Duration	895.2540

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Depart Engine	Depart Propell	Depart Tankage	Arrive Engine	Arrive Propell	Arrive Tankage	Inert	Probes	AeroBrk	Drops	Samples	NetMass
1	110.703	6.000	28.386	0.000	0.000	0.000	0.000	0.600	17.312	13.100	0.000	0.000	45.305
2	45.905	6.300	9.245	0.000	0.000	0.000	0.000	0.600	23.560	0.000	0.000	0.000	6.200

DEPARTURE/ARRIVAL CONDITIONS

Leg	Depart V Inf (km/s)	Depart Decl (deg)	Depart Rt Asc (deg)	Depart Brn Tm (min)	Depart Del V (km/s)	Depart VLoss (m/s)	Arrive V Inf (km/s)	Arrive Decl (deg)	Arrive Rt Asc (deg)	Arrive Brn Tm (min)	Arrive Del V (km/s)	Arrive VLoss (m/s)
1	4.29196	0.57	159.31	19.528	1.34636	47.335	5.01397	-9.05	311.66	0.000	0.00000	0.000
2	2.79974	22.30	160.17	6.068	0.97502	2.970	6.81300	15.54	84.03	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.2277061	0.226913880	0.98916	306.17965	143.69927	36.38050	164.49424	0.9491225	1.5062896	496.86635
2	1.3029501	0.287871120	1.65105	107.77948	232.39970	194.26415	307.54158	0.9278684	1.6780318	543.23794

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
800.00000	51.60000	1.34636	-35.58464	124.31120	-0.61720	0.90441	-0.78346
800.00000	51.60000	1.34636	36.50952	123.83572	-0.60256	0.89888	0.80103

1.299 NU 5-L 05525

MISSION OPERATIONS

	Earth Dep	Helio	Mars Arr	Mars Dep	Helio	Earth Arr
Times (days)						
Depart/Arrive	0.00		184.00	705.25		895.25
Flight/Stay		184.00		521.25	190.00	
Esc/Cap Orbits (radii)						
Apoapse Distance	12.09		0.00	10.95		0.00
Periapse Distance	1.13		0.00	1.07		0.00
Spacecraft Distances (AU)						
Minimum Heliocentric		0.9846			1.0166	
Maximum Heliocentric		1.4904			1.6574	
Geocentric	0.0000		1.1737	1.6764		0.0000
Maneuvers						
Propulsion Type	Vloss		None	Vloss		None
Vinf (km/sec)	4.29		5.01	2.80		6.81
Eff Delta-V (km/sec)	1.35	0.00	0.00	0.98	0.00	0.00
Vel Losses (m/sec)	47.33		0.00	2.97		0.00
Propellant (kg or t)	28.39	0.00	0.00	9.25	0.00	0.00
Burn time (hr)	0.33		0.00	0.10		0.00
Thrust (lbs or klbs)	24.75		0.00	24.75		0.00
Spec Imp (sec)	463.4		0.0	442.1		0.0
Mass Changes (kg or t)						
Dry Stage Jettisoned	6.00		0.00	6.30		0.00
Probes Separated			17.31			23.56
AeroBrake Separated			13.10			0.00
Drop Mass Left			0.00			0.00
Sample Mass Added			0.00			0.00

File Name: Loaded Case

(Converged)

PERFORMANCE SUMMARY

Stay Time (days)	Depart		Arrive		Flight Time (days)
	Earth	JAN 26, 2014, 16.8000 hours GMT Julian Date 56684.2000	Mars	AUG 14, 2014, 16.8000 hours GMT Julian Date 56884.2000	200.0000
505.0540	Mars	JAN 1, 2016, 18.0957 hours GMT Julian Date 57389.2540	Earth	JUL 9, 2016, 18.0957 hours GMT Julian Date 57579.2540	190.0000
				Total Duration	895.0540

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Depart Engine	Depart Propell	Depart Tankage	Arrive Engine	Arrive Propell	Arrive Tankage	Inert	Probes	AeroBrk	Drops	Samples	NetMass
1	110.681	6.000	28.364	0.000	0.000	0.000	0.000	0.600	17.312	13.100	0.000	0.000	45.305
2	45.905	6.300	9.245	0.000	0.000	0.000	0.000	0.600	23.560	0.000	0.000	0.000	6.200

DEPARTURE/ARRIVAL CONDITIONS

Leg	Depart V Inf (km/s)	Depart Decl (deg)	Depart Rt Asc (deg)	Depart Brn Tm (min)	Depart Del V (km/s)	Depart VLoss (m/s)	Arrive V Inf (km/s)	Arrive Decl (deg)	Arrive Rt Asc (deg)	Arrive Brn Tm (min)	Arrive Del V (km/s)	Arrive VLoss (m/s)
1	4.28990	-2.18	155.61	19.513	1.34548	47.227	4.24119	-6.53	306.78	0.000	0.00000	0.000
2	2.79974	22.30	160.17	6.068	0.97502	2.970	6.81300	15.54	84.03	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.2083607	0.217260067	1.50657	306.41051	141.23863	38.81359	175.67506	0.9458322	1.4708893	485.16932
2	1.3029501	0.287871121	1.65105	107.77948	232.39969	194.26415	307.54158	0.9278684	1.6780318	543.23794

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
800.00000	51.60000	1.34548	-37.81213	119.38488	-0.52157	0.92621	-0.82488
800.00000	51.60000	1.34548	34.24758	121.22146	-0.57650	0.95111	0.75720

MISSION OPERATIONS

	Earth Dep	Helio	Mars Arr	Mars Dep	Helio	Earth Arr
Times (days)						
Depart/Arrive	0.00		200.00	705.05		895.05
Flight/Stay		200.00	505.05		190.00	
Esc/Cap Orbits (radii)						
Apoapse Distance	12.09		0.00	10.95		0.00
Periapse Distance	1.13		0.00	1.07		0.00
Spacecraft Distances (AU)						
Minimum Heliocentric		0.9846			1.0166	
Maximum Heliocentric		1.4697			1.6574	
Geocentric	0.0000		1.2733	1.6764		0.0000
Maneuvers						
Propulsion Type	Vloss		None	Vloss		None
Vinf (km/sec)	4.29		4.24	2.80		6.81
Eff Delta-V (km/sec)	1.35	0.00	0.00	0.98	0.00	0.00
Vel Losses (m/sec)	47.23		0.00	2.97		0.00
Propellant (kg or t)	28.36	0.00	0.00	9.25	0.00	0.00
Burn time (hr)	0.33		0.00	0.10		0.00
Thrust (lbs or klbs)	24.75		0.00	24.75		0.00
Spec Imp (sec)	463.4		0.0	442.1		0.0
Mass Changes (kg or t)						
Dry Stage Jettisoned	6.00		0.00	6.30		0.00
Probes Separated			17.31			23.56
AeroBrake Separated			13.10			0.00
Drop Mass Left			0.00			0.00
Sample Mass Added			0.00			0.00

Mars Human Loaded Case

Unmanned

PERFORMANCE SUMMARY

Stay Time (days)	Depart		Arrive		Flight Time (days)
	Earth	SEP 8, 2022, 11.0204 hours GMT Julian Date 59830.9592	Mars	MAR 27, 2023, 11.0204 hours GMT Julian Date 60030.9592	200.0000
515.0367	Mars	AUG 23, 2024, 11.9006 hours GMT Julian Date 60545.9959	Earth	MAR 11, 2025, 11.9006 hours GMT Julian Date 60745.9959	200.0000
				Total Duration	915.0367

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Depart Engine	Depart Propell	Depart Tankage	Arrive Engine	Arrive Propell	Arrive Tankage	Inert	Probes	AeroBrk	Drops	Samples	NetMass
1	171.006	12.500	63.989	0.000	10.119	14.896	0.000	0.000	0.000	0.000	0.000	0.000	69.503
2	69.503	0.000	11.115	0.000	0.000	0.000	0.000	0.000	52.583	0.000	0.000	0.000	5.805

DEPARTURE/ARRIVAL CONDITIONS

Leg	Depart V Inf (km/s)	Depart Decl (deg)	Depart Rt Asc (deg)	Depart Brn Tm (min)	Depart Del V (km/s)	Depart VLoss (m/s)	Arrive V Inf (km/s)	Arrive Decl (deg)	Arrive Rt Asc (deg)	Arrive Brn Tm (min)	Arrive Del V (km/s)	Arrive VLoss (m/s)
1	4.29600	44.80	59.80	23.764	1.84618	68.212	3.78554	-19.36	186.20	11.153	1.54222	17.509
	Burn 2 Coast = 4.60 hrs			24.148	2.36876	150.412						
2	3.83794	0.42	29.07	8.322	1.56706	9.952	6.26432	-8.06	336.53	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.3873974	0.273857472	2.95727	345.46737	358.76193	1.24739	143.50331	1.0074482	1.7673465	596.89747
2	1.1913417	0.233405543	0.32232	170.85059	57.71750	173.15022	302.24574	0.9057634	1.4573201	469.10713

PLANETOCENTRIC CAPTURE ORBIT ELEMENTS

Leg	Semi-Axis (radii)	Eccentricity	Inclination (deg)	Asc Node1 (deg)	Arg Per1 (deg)	Asc Node2 (deg)	Arg Per2 (deg)	Periapse (radii)	Apoapse (radii)	Period (hours)
	6.0107448	0.821387467	37.00000	213.98325	263.35220	338.41046	150.18555	1.0735943	10.9478952	24.60638

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
400.00000	44.79961	4.21493	27.19508	0.95873	3.74847	0.06273	1.92632
					.5593	.0149	.4570

MISSION OPERATIONS

	Earth Dep	Helio	Mars Arr	Mars Dep	Helio	Earth Arr
Times (Days)						
Depart/Arrive	0.00		200.00	715.04		915.04
Flight Stay		200.00	515.04		200.00	
Dep/Cap Orbits (radii)						
Apoapse Distance	1.06		10.95	10.95		0.00
Periapse Distance	1.06		1.07	1.07		0.00
Spacecraft Distances (AU)						
Minimum Heliocentric		1.0075			0.9935	
Maximum Heliocentric		1.6456			1.4573	
Geocentric	0.0000		1.4090	1.4798		0.0000
Maneuvers						
Propulsion Type	Vloss		Vloss	Vloss		None
Vinf (km/sec)	4.30		3.79	3.84		6.26
Eff Delta-V (km/sec)	4.21	0.00	1.54	1.57	0.00	0.00
Vel Losses (m/sec)	218.62		17.51	9.95		0.00
Propellant (kg or t)	63.99	0.00	14.90	11.11	0.00	0.00
Burn time (hr)	0.80		0.19	0.14		0.00
Thrust (lbs or klbs)	45.00		45.00	45.00		0.00
Spec Imp (sec)	917.0		917.0	917.0		0.0
Mass Changes (kg or t)						
Dry Stage Jettisoned	12.50		10.12	0.00		0.00
Probes Separated			0.00			52.58
AeroBrake Separated			0.00			0.00
Drop Mass Left			0.00			0.00
Sample Mass Added			0.00			0.00

[illegible]

[illegible]

PERFORMANCE SUMMARY

Leg	Stay Time (days)	Depart		Arrive		Flight Time (days)
1		Earth	SEP 9, 2022, 12.0000 hours GMT Julian Date 59832.0000	Mars	MAR 28, 2023, 12.0000 hours GMT Julian Date 60032.0000	200.0000
2	113.9959	Mars	AUG 23, 2024, 11.9005 hours GMT Julian Date 60545.9959	Earth	MAR 11, 2025, 11.9005 hours GMT Julian Date 60745.9959	200.0000
					Total Duration	913.9959

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Depart Engine	Depart Propell	Depart Tankage	Arrive Engine	Arrive Propell	Arrive Tankage	Inert	Probes	AeroBrk	Drops	Samples	NetMass
1	170.609	12.500	63.840	0.000	10.119	14.647	0.000	0.000	0.000	0.000	0.000	0.000	69.503
2	69.503	0.000	11.115	0.000	0.000	0.000	0.000	0.000	52.583	0.000	0.000	0.000	5.805

DEPARTURE/ARRIVAL CONDITIONS

Leg	Depart V Inf (km/s)	Depart Decl (deg)	Depart Rt Asc (deg)	Depart Brn Tm (min)	Depart Del V (km/s)	Depart VLoss (m/s)	Arrive V Inf (km/s)	Arrive Decl (deg)	Arrive Rt Asc (deg)	Arrive Brn Tm (min)	Arrive Del V (km/s)	Arrive VLoss (m/s)
1	4.29871	44.33	58.70	23.710	1.84627	67.916	3.74844	-19.22	186.33	10.967	1.51856	16.615
	Burn 2 Coast = 4.60 hrs			24.091	2.36867	149.716						
2	3.83794	0.42	29.07	8.322	1.56706	9.952	6.26432	-8.06	336.53	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.3857609	0.273290302	2.92626	346.47904	357.71749	2.29092	144.00226	1.0070604	1.7645014	595.85459
2	1.1815417	0.233405512	0.32232	170.85059	57.71749	173.15022	302.24574	0.9057634	1.4573201	469.10712

PLANETOCENTRIC CAPTURE ORBIT ELEMENTS

Leg	Semi-Axis (radii)	Eccentricity	Inclination (deg)	Asc Node1 (deg)	Arg Per1 (deg)	Asc Node2 (deg)	Arg Per2 (deg)	Periapse (radii)	Apoapse (radii)	Period (hours)
2	6.0107446	0.821387467	37.00000	213.88451	263.92616	338.77848	150.23883	1.0735943	10.9478952	24.60638

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
400.00000	44.33087	4.21494	26.96392	0.08015	3.75674	0.00526	1.91118

MISSION OPERATIONS

	Earth Dep	Helio	Mars Arr	Mars Dep	Helio	Earth Arr
Times (days)						
Depart/Arrive	0.00		200.00	714.00		914.00
Flight/Stay		200.00		514.00	200.00	
Esc/Cap Orbits (radii)						
Apoapse Distance	1.06		10.95	10.95		0.00
Periapse Distance	1.06		1.07	1.07		0.00
Spacecraft Distances (AU)						
Minimum Heliocentric		1.0072			0.9935	
Maximum Heliocentric		1.6463			1.4573	
Geocentric	0.0000		1.4193	1.4798		0.0000
Maneuvers						
Propulsion Type	Vloss		Vloss	Vloss		None
Vinf (km/sec)	4.30		3.75	3.84		6.26
Eff Delta-V (km/sec)	4.21	0.00	1.52	1.57	0.00	0.00
Vel Losses (m/sec)	217.63		16.61	9.95		0.00
Propellant (kg or t)	63.84	0.00	14.65	11.11	0.00	0.00
Burn time (hr)	0.80		0.18	0.14		0.00
Thrust (lbs or klbs)	45.00		45.00	45.00		0.00
Spec Imp (sec)	917.0		917.0	917.0		0.0
Mass Changes (kg or t)						
Dry Stage Jettisoned	12.50		10.12	0.00		0.00
Probes Separated				0.00		52.58
AeroBrake Separated				0.00		0.00
Up Mass Left				0.00		0.00
Mass Added				0.00		0.00

[illegible] Loaded Case

(Converged)

PERFORMANCE SUMMARY

Leg	Flight Time (days)	Depart		Arrive		Flight Time (days)
1		Earth	SEP 10, 2022, 12.0000 hours GMT Julian Date 59833.0000	Mars	MAR 29, 2023, 12.0000 hours GMT Julian Date 60033.0000	200.0000
2	712.9959	Mars	AUG 23, 2024, 11.9004 hours GMT Julian Date 60545.9959	Earth	MAR 11, 2025, 11.9004 hours GMT Julian Date 60745.9959	200.0000
					Total Duration	912.9959

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Depart Engine	Depart Propell	Depart Tankage	Arrive Engine	Arrive Propell	Arrive Tankage	Inert	Probes	AeroBrk	Drops	Samples	NetMass
1	170.266	12.500	63.732	0.000	10.119	14.412	0.000	0.000	0.000	0.000	0.000	0.000	69.503
2	69.503	0.000	11.115	0.000	0.000	0.000	0.000	0.000	52.583	0.000	0.000	0.000	5.805

DEPARTURE/ARRIVAL CONDITIONS

Leg	Depart V Inf (km/s)	Depart Decl (deg)	Depart Rt Asc (deg)	Depart Brn Tm (min)	Depart Del V (km/s)	Depart VLoss (m/s)	Arrive V Inf (km/s)	Arrive Decl (deg)	Arrive Rt Asc (deg)	Arrive Brn Tm (min)	Arrive Del V (km/s)	Arrive VLoss (m/s)
1	4.30496	43.86	57.65	23.670	1.84700	67.742	3.71291	-19.08	186.44	10.791	1.49606	15.795
	Burn 2 Coast = 4.61 hrs			24.049	2.36966	149.306						
2	3.83794	0.42	29.07	8.322	1.56706	9.952	6.26432	-8.06	336.53	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.3841920	0.272776903	2.89717	347.45155	356.70365	3.30386	144.49113	1.0066164	1.7617676	594.83008
2	1.1815417	0.233405492	0.32232	170.85060	57.71748	173.15022	302.24575	0.9057634	1.4573200	469.10711

PLANETOCENTRIC CAPTURE ORBIT ELEMENTS

Leg	Semi-Axis (radii)	Eccentricity	Inclination (deg)	Asc Node1 (deg)	Arg Per1 (deg)	Asc Node2 (deg)	Arg Per2 (deg)	Periapse (radii)	Apoapse (radii)	Period (hours)
2	6.0107448	0.821387467	37.00000	213.76091	264.49447	339.12667	150.27995	1.0735943	10.9478952	24.60638

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
400.00000	43.86118	4.21666	26.74616	359.28147	3.76522	-0.04722	1.89766

MISSION OPERATIONS

	Earth Dep	Helio	Mars Arr	Mars Dep	Helio	Earth Arr
Times (days)						
Depart/Arrive	0.00		200.00	713.00		913.00
Flight/Stay		200.00		513.00	200.00	
Esc/Cap Orbits (radii)						
Apoapse Distance	1.06		10.95	10.95		0.00
Periapse Distance	1.06		1.07	1.07		0.00
Spacecraft Distances (AU)						
Minimum Heliocentric		1.0070			0.9935	
Maximum Heliocentric		1.6469			1.4573	
Geocentric	0.0000		1.4292	1.4798		0.0000
Maneuvers						
Propulsion Type	Vloss		Vloss	Vloss		None
Vinf (km/sec)	4.30		3.71	3.84		6.26
Eff Delta-V (km/sec)	4.22	0.00	1.50	1.57	0.00	0.00
Vel Losses (m/sec)	217.05		15.80	9.95		0.00
Propellant (kg or t)	63.73	0.00	14.41	11.11	0.00	0.00
Burn time (hr)	0.80		0.18	0.14		0.00
Thrust (lbs or klbs)	45.00		45.00	45.00		0.00
Spec Imp (sec)	917.0		917.0	917.0		0.0
Mass Changes (kg or t)						
Dry Stage Jettisoned	12.50		10.12	0.00		0.00
Probes Separated			0.00			52.58
AeroBrake Separated			0.00			0.00
Drop Mass Left			0.00			0.00
Sample Mass Added			0.00			0.00

Fully Fueled Loaded Case

(Converged)

PERFORMANCE SUMMARY

Day Time (days)	Depart		Arrive		Flight Time (days)
	Earth	SEP 11, 2022, 12.0000 hours GMT Julian Date 59834.0000	Mars	MAR 30, 2023, 12.0000 hours GMT Julian Date 60034.0000	200.0000
511.9958	Mars	AUG 23, 2024, 11.9003 hours GMT Julian Date 60545.9958	Earth	MAR 11, 2025, 11.9003 hours GMT Julian Date 60745.9958	200.0000
				Total Duration	911.9958

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Depart Engine	Depart Propell	Depart Tankage	Arrive Engine	Arrive Propell	Arrive Tankage	Inert	Probes	AeroBrk	Drops	Samples	NetMass
1	169.959	12.500	63.657	0.000	10.119	14.179	0.000	0.000	0.000	0.000	0.000	0.000	69.503
2	69.503	0.000	11.115	0.000	0.000	0.000	0.000	0.000	52.583	0.000	0.000	0.000	5.805

DEPARTURE/ARRIVAL CONDITIONS

Leg	Depart V Inf (km/s)	Depart Decl (deg)	Depart Rt Asc (deg)	Depart Brn Tm (min)	Depart Del V (km/s)	Depart VLoss (m/s)	Arrive V Inf (km/s)	Arrive Decl (deg)	Arrive Rt Asc (deg)	Arrive Brn Tm (min)	Arrive Del V (km/s)	Arrive VLoss (m/s)
1	4.31482	43.37	56.63	23.643	1.84835	67.676	3.67749	-18.93	186.54	10.617	1.47380	15.014
Burn 2	Coast =	4.61 hrs		24.020	2.37173	149.150						
2	3.83794	0.42	29.07	8.322	1.56706	9.952	6.26432	-8.06	336.53	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.3825683	0.272295783	2.86875	348.42459	355.67973	4.32685	144.98922	1.0061008	1.7590358	593.78375
2	1.1815417	0.233405452	0.32232	170.85060	57.71747	173.15022	302.24576	0.9057634	1.4573200	469.10711

PLANETOCENTRIC CAPTURE ORBIT ELEMENTS

Leg	Semi-Axis (radii)	Eccentricity	Inclination (deg)	Asc Node1 (deg)	Arg Per1 (deg)	Asc Node2 (deg)	Arg Per2 (deg)	Periapse (radii)	Apoapse (radii)	Period (hours)
2	6.0107448	0.821387467	37.00000	213.60822	265.07982	339.46967	150.31042	1.0735943	10.9478952	24.60638

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
400.00000	43.37384	4.22008	26.53275	358.53089	3.77438	-0.09680	1.88515

MISSION OPERATIONS

	Earth Dep	Helio	Mars Arr	Mars Dep	Helio	Earth Arr
Times (days)						
Depart/Arrive	0.00		200.00	712.00		912.00
Flight/Stay		200.00	512.00		200.00	
Esc Cap Orbits (radii)						
Apoapse Distance	1.06		10.95	10.95		0.00
Periapse Distance	1.06		1.07	1.07		0.00
Spacecraft Distances (AU)						
Minimum Heliocentric		1.0067			0.9935	
Maximum Heliocentric		1.6475			1.4573	
Geocentric	0.0000		1.4391	1.4798		0.0000
Maneuvers						
Propulsion Type	Vloss		Vloss	Vloss		None
Vinf (km/sec)	4.31		3.68	3.84		6.26
Eff Delta-V (km/sec)	4.22	0.00	1.47	1.57	0.00	0.00
Vel Losses (m/sec)	216.83		15.01	9.95		0.00
Propellant (kg or t)	63.66	0.00	14.18	11.11	0.00	0.00
Burn time (hr)	0.79		0.18	0.14		0.00
Thrust (lbs or klbs)	45.00		45.00	45.00		0.00
Spec Imp (sec)	917.0		917.0	917.0		0.0
Mass Changes (kg or t)						
Dry Stage Jettisoned	12.50		10.12	0.00		0.00
Probes Separated			0.00			52.58
AeroBrake Separated			0.00			0.00
Prop Mass Left			0.00			0.00
Sample Mass Added			0.00			0.00

File Name: Loaded Case

(Converged)

PERFORMANCE SUMMARY

Stay Time (days)	Depart		Arrive		Flight Time (days)
	Earth	SEP 14, 2022, 16.2176 hours GMT Julian Date 59837.1757	Mars	OCT 2, 2023, 16.4488 hours GMT Julian Date 60220.1854	383.0096
				Total Duration	383.0096

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Depart Engine	Depart Propell	Depart Tankage	Arrive Engine	Arrive Propell	Arrive Tankage	Inert	Probes	AeroBrk	Drops	Samples	NetMass
1	63.949	4.400	18.278	0.000	0.000	0.000	0.000	0.000	0.000	9.800	0.000	0.000	51.520

DEPARTURE/ARRIVAL CONDITIONS

Leg	Depart V Inf (km/s)	Depart Decl (deg)	Depart Rt Asc (deg)	Depart Brn Tm (min)	Depart Del V (km/s)	Depart VLoss (m/s)	Arrive V Inf (km/s)	Arrive Decl (deg)	Arrive Rt Asc (deg)	Arrive Brn Tm (min)	Arrive Del V (km/s)	Arrive VLoss (m/s)
1	3.71368	15.73	82.13	12.912	1.11035	16.598	3.07417	19.53	177.69	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.3537868	0.257394533	0.83739	171.53339	184.16113	355.82721	216.59685	1.0053295	1.7022441	575.33903

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
800.00000	28.50000	1.11035	-8.76212	34.39598	0.90552	0.61993	-0.16914
800.00000	28.50000	1.11035	28.47797	25.81885	0.87857	0.42507	0.52944

MISSION OPERATIONS

	Earth Dep	Helio	Mars Arr
Times (days)			
Depart/Arrive	0.00		383.01
Flight/Stay		383.01	
Esc/Cap Orbits (radii)			
Apoapse Distance	12.09		0.00
Periapse Distance	1.13		0.00
Spacecraft Distances (AU)			
Minimum Heliocentric		1.0053	
Maximum Heliocentric		1.7022	
Geocentric	0.0000		2.5432
Maneuvers			
Propulsion Type	Vloss		None
Vinf (km/sec)	3.71		3.07
Eff Delta-V (km/sec)	1.11	0.00	0.00
Vel Losses (m/sec)	16.60		0.00
Propellant (kg or t)	18.28	0.00	0.00
Burn time (hr)	0.22		0.00
Thrust (lbs or klbs)	24.00		0.00
Spec Imp (sec)	461.4		0.0
Mass Changes (kg or t)			
Dry Stage Jettisoned	4.40		0.00
Probes Separated			0.00
AeroBrake Separated			9.80
Drop Mass Left			0.00
Sample Mass Added			0.00

Case Name: Loaded Case

Case 1 (Converged)

PERFORMANCE SUMMARY

Leg	Stay Time (days)	Depart		Arrive		Flight Time (days)
1		Earth	SEP 2, 2022, 12.0000 hours GMT Julian Date 59825.0000	Mars	MAR 21, 2023, 12.0000 hours GMT Julian Date 60025.0000	200.0000
2	520.9959	Mars	AUG 23, 2024, 11.9013 hours GMT Julian Date 60545.9959	Earth	MAR 11, 2025, 11.9013 hours GMT Julian Date 60745.9959	200.0000
					Total Duration	920.9959

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Depart Engine	Depart Propell	Depart Tankage	Arrive Engine	Arrive Propell	Arrive Tankage	Inert	Probes	AeroBrk	Drops	Samples	NetMass
1	119.573	6.000	31.338	0.000	0.000	0.000	0.000	0.000	17.312	13.100	0.000	0.000	51.823
2	51.823	6.300	15.765	0.000	0.000	0.000	0.000	0.000	23.558	0.000	0.000	0.000	6.200

DEPARTURE/ARRIVAL CONDITIONS

Leg	Depart V Inf (km/s)	Depart Decl (deg)	Depart Rt Asc (deg)	Depart Brn Tm (min)	Depart Del V (km/s)	Depart VLoss (m/s)	Arrive V Inf (km/s)	Arrive Decl (deg)	Arrive Rt Asc (deg)	Arrive Brn Tm (min)	Arrive Del V (km/s)	Arrive VLoss (m/s)
1	4.35193	47.04	66.17	21.559	1.38114	59.355	3.99932	-20.02	185.10	0.000	0.00000	0.000
2	3.83794	0.42	29.07	10.347	1.57251	15.412	6.26433	-8.06	336.53	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.3959036	0.277675579	3.15084	339.68569	4.52754	355.48651	140.84297	1.0082952	1.7835119	602.39528
2	1.1815418	0.233405721	0.32231	170.85059	57.71757	173.15022	302.24569	0.9057632	1.4573204	469.10717

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
800.00000	51.60000	1.38114	16.18077	21.12350	1.23730	0.47802	0.38488
800.00000	51.60000	1.38114	44.15737	354.83956	0.98685	-0.08912	0.96214

MISSION OPERATIONS

	Earth Dep	Helio	Mars Arr	Mars Dep	Helio	Earth Arr
Times (days)						
Depart/Arrive	0.00		200.00	721.00		921.00
Flight/Stay		200.00		521.00	200.00	
Esc/Cap Orbits (radii)						
Apoapse Distance	12.09		0.00	10.95		0.00
Periapse Distance	1.13		0.00	1.07		0.00
Spacecraft Distances (AU)						
Minimum Heliocentric		1.0083			0.9935	
Maximum Heliocentric		1.6418			1.4573	
Geocentric	0.0000		1.3497	1.4798		0.0000
Maneuvers						
Propulsion Type	Vloss		None	Vloss		None
Vinf (km/sec)	4.35		4.00	3.84		6.26
Eff Delta-V (km/sec)	1.38	0.00	0.00	1.57	0.00	0.00
Vel Losses (m/sec)	59.36		0.00	15.41		0.00
Propellant (kg or t)	31.34	0.00	0.00	15.76	0.00	0.00
Burn time (hr)	0.36		0.00	0.17		0.00
Thrust (lbs or klbs)	24.75		0.00	24.75		0.00
Spec Imp (sec)	463.4		0.0	442.1		0.0
Mass Changes (kg or t)						
Dry Stage Jettisoned	6.00		0.00	6.30		0.00
Probes Separated			17.31			23.56
AeroBrake Separated			13.10			0.00
Drop Mass Left			0.00			0.00
Sample Mass Added			0.00			0.00

File Name: Loaded Case

1 (Converged)

PERFORMANCE SUMMARY

Leg	Stay Time (days)	Depart		Arrive		Flight Time (days)
1		Earth	SEP 4, 2022, 12.0000 hours GMT Julian Date 59827.0000	Mars	MAR 23, 2023, 12.0000 hours GMT Julian Date 60027.0000	200.0000
2	518.9959	Mars	AUG 23, 2024, 11.9010 hours GMT Julian Date 60545.9959	Earth	MAR 11, 2025, 11.9010 hours GMT Julian Date 60745.9959	200.0000
					Total Duration	918.9959

SPACECRAFT MASS SUMMARY (kg or t)

		Depart			Arrive								
Leg	Initial	Engine	Propell	Tankage	Engine	Propell	Tankage	Inert	Probes	AeroBrk	Drops	Samples	NetMass
1	119.199	6.000	30.964	0.000	0.000	0.000	0.000	0.000	17.312	13.100	0.000	0.000	51.823
2	51.823	6.300	15.765	0.000	0.000	0.000	0.000	0.000	23.558	0.000	0.000	0.000	6.200

DEPARTURE/ARRIVAL CONDITIONS

	Depart						Arrive					
Leg	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)
1	4.32003	46.38	64.05	21.302	1.36691	57.261	3.92739	-19.82	185.53	0.000	0.00000	0.000
2	3.83794	0.42	29.07	10.347	1.57251	15.412	6.26432	-8.06	336.53	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.3931928	0.276294349	3.08263	341.62414	2.63335	357.37920	141.69838	1.0082615	1.7781241	600.64138
2	1.1815418	0.233405661	0.32231	170.85059	57.71755	173.15022	302.24571	0.9057632	1.4573203	469.10716

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
800.00000	51.60000	1.36691	14.79379	19.86671	1.24294	0.44912	0.34903
800.00000	51.60000	1.36691	44.81383	352.26459	0.96086	-0.13052	0.96340

MISSION OPERATIONS

	Earth Dep	Helio	Mars Arr	Mars Dep	Helio	Earth Arr
Times (days)						
Depart/Arrive	0.00		200.00	719.00		919.00
Flight/Stay		200.00		519.00	200.00	
Esc/Cap Orbits (radii)						
Apoapse Distance	12.09		0.00	10.95		0.00
Periapse Distance	1.13		0.00	1.07		0.00
Spacecraft Distances (AU)						
Minimum Heliocentric		1.0083			0.9935	
Maximum Heliocentric		1.6431			1.4573	
Geocentric	0.0000		1.3697	1.4798		0.0000
Maneuvers						
Propulsion Type	Vloss		None	Vloss		None
Vinf (km/sec)	4.32		3.93	3.84		6.26
Eff Delta-V (km/sec)	1.37	0.00	0.00	1.57	0.00	0.00
Vel Losses (m/sec)	57.26		0.00	15.41		0.00
Propellant (kg or t)	30.96	0.00	0.00	15.76	0.00	0.00
Burn time (hr)	0.36		0.00	0.17		0.00
Thrust (lbs or klbs)	24.75		0.00	24.75		0.00
Spec Imp (sec)	463.4		0.0	442.1		0.0
Mass Changes (kg or t)						
Dry Stage Jettisoned	6.00		0.00	6.30		0.00
Probes Separated			17.31			23.56
AeroBrake Separated			13.10			0.00
Drop Mass Left			0.00			0.00
Sample Mass Added			0.00			0.00

File Name: Loaded Case

1 (Converged)

PERFORMANCE SUMMARY

Stay Time (days)	Depart		Arrive		Flight Time (days)
	Earth	SEP 6, 2022, 12.0000 hours GMT Julian Date 59829.0000	Mars	MAR 25, 2023, 12.0000 hours GMT Julian Date 60029.0000	200.0000
516.9959	Mars	AUG 23, 2024, 11.9008 hours GMT Julian Date 60545.9959	Earth	MAR 11, 2025, 11.9008 hours GMT Julian Date 60745.9959	200.0000
				Total Duration	916.9959

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Depart Engine	Depart Propell	Depart Tankage	Arrive Engine	Arrive Propell	Arrive Tankage	Inert	Probes	AeroBrk	Drops	Samples	NetMass
1	118.981	6.000	30.746	0.000	0.000	0.000	0.000	0.000	17.312	13.100	0.000	0.000	51.823
2	51.823	6.300	15.765	0.000	0.000	0.000	0.000	0.000	23.558	0.000	0.000	0.000	6.200

DEPARTURE/ARRIVAL CONDITIONS

Leg	Depart V Inf (km/s)	Depart Decl (deg)	Depart Rt Asc (deg)	Depart Brn Tm (min)	Depart Del V (km/s)	Depart VLoss (m/s)	Arrive V Inf (km/s)	Arrive Decl (deg)	Arrive Rt Asc (deg)	Arrive Brn Tm (min)	Arrive Del V (km/s)	Arrive VLoss (m/s)
1	4.30121	45.62	61.90	21.152	1.35858	56.062	3.85562	-19.60	185.90	0.000	0.00000	0.000
2	3.83794	0.42	29.07	10.347	1.57251	15.412	6.26432	-8.06	336.53	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.3903358	0.275010618	3.01779	343.56458	0.69785	359.31311	142.59166	1.0079787	1.7726929	598.79473
2	1.1815418	0.233405601	0.32232	170.85059	57.71753	173.15022	302.24572	0.9057633	1.4573202	469.10714

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
800.00000	51.60000	1.35858	13.38983	18.67918	1.25204	0.42328	0.31461
800.00000	51.60000	1.35858	45.54365	349.87332	0.93668	-0.16730	0.96973

MISSION OPERATIONS

	Earth Dep	Helio	Mars Arr	Mars Dep	Helio	Earth Arr
Times (days)						
Depart/Arrive	0.00		200.00	717.00		917.00
Flight/Stay		200.00	517.00		200.00	
Esc/Cap Orbits (radii)						
Apoapse Distance	12.09		0.00	10.95		0.00
Periapse Distance	1.13		0.00	1.07		0.00
Spacecraft Distances (AU)						
Minimum Heliocentric		1.0080			0.9935	
Maximum Heliocentric		1.6444			1.4573	
Geocentric	0.0000		1.3896	1.4798		0.0000
Maneuvers						
Propulsion Type	Vloss		None	Vloss		None
Vinf (km/sec)	4.30		3.86	3.84		6.26
Eff Delta-V (km/sec)	1.36	0.00	0.00	1.57	0.00	0.00
Vel Losses (m/sec)	56.06		0.00	15.41		0.00
Propellant (kg or t)	30.75	0.00	0.00	15.76	0.00	0.00
Burn time (hr)	0.35		0.00	0.17		0.00
Thrust (lbs or klbs)	24.75		0.00	24.75		0.00
Spec Imp (sec)	463.4		0.0	442.1		0.0
Mass Changes (kg or t)						
Dry Stage Jettisoned	6.00		0.00	6.30		0.00
Probes Separated			17.31			23.56
AeroBrake Separated			13.10			0.00
Drop Mass Left			0.00			0.00
Sample Mass Added			0.00			0.00

File Name: Loaded Case

(Converged)

PERFORMANCE SUMMARY

Stay Time (days)	Depart		Arrive		Flight Time (days)
	Earth	SEP 7, 2022, 12.0000 hours GMT Julian Date 59830.0000	Mars	MAR 26, 2023, 12.0000 hours GMT Julian Date 60030.0000	200.0000
515.9959	Mars	AUG 23, 2024, 11.9007 hours GMT Julian Date 60545.9959	Earth	MAR 11, 2025, 11.9007 hours GMT Julian Date 60745.9959	200.0000
				Total Duration	915.9959

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Depart Engine	Depart Propell	Depart Tankage	Arrive Engine	Arrive Propell	Arrive Tankage	Inert	Probes	AeroBrk	Drops	Samples	NetMass
1	118.931	6.000	30.696	0.000	0.000	0.000	0.000	0.000	17.312	13.100	0.000	0.000	51.823
2	51.823	6.300	15.765	0.000	0.000	0.000	0.000	0.000	23.558	0.000	0.000	0.000	6.200

DEPARTURE/ARRIVAL CONDITIONS

Leg	Depart V Inf (km/s)	Depart Decl (deg)	Depart Rt Asc (deg)	Depart Brn Tm (min)	Depart Del V (km/s)	Depart VLoss (m/s)	Arrive V Inf (km/s)	Arrive Decl (deg)	Arrive Rt Asc (deg)	Arrive Brn Tm (min)	Arrive Del V (km/s)	Arrive VLoss (m/s)
1	4.29688	45.21	60.82	21.118	1.35668	55.790	3.81981	-19.48	186.06	0.000	0.00000	0.000
2	3.83794	0.42	29.07	10.347	1.57251	15.412	6.26432	-8.06	336.53	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.3888531	0.274408499	2.98654	344.53555	359.71465	0.29549	143.05247	1.0077400	1.7699662	597.83714
2	1.1815418	0.233405571	0.32232	170.85059	57.71751	173.15022	302.24573	0.9057633	1.4573202	469.10713

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
800.00000	51.60000	1.35668	12.68680	18.11631	1.25794	0.41156	0.29796
800.00000	51.60000	1.35668	45.92999	348.76943	0.92555	-0.18378	0.97476

MISSION OPERATIONS

	Earth Dep	Helio	Mars Arr	Mars Dep	Helio	Earth Arr
Times (days)						
Depart/Arrive	0.00		200.00	716.00		916.00
Flight/Stay		200.00		516.00	200.00	
Esc/Cap Orbits (radii)						
Apoapse Distance	12.09		0.00	10.95		0.00
Periapse Distance	1.13		0.00	1.07		0.00
Spacecraft Distances (AU)						
Minimum Heliocentric		1.0077			0.9935	
Maximum Heliocentric		1.6450			1.4573	
Geocentric	0.0000		1.3995	1.4798		0.0000
Maneuvers						
Propulsion Type	Vloss		None	Vloss		None
Vinf (km/sec)	4.30		3.82	3.84		6.26
Eff Delta-V (km/sec)	1.36	0.00	0.00	1.57	0.00	0.00
Vel Losses (m/sec)	55.79		0.00	15.41		0.00
Propellant (kg or t)	30.70	0.00	0.00	15.76	0.00	0.00
Burn time (hr)	0.35		0.00	0.17		0.00
Thrust (lbs or klbs)	24.75		0.00	24.75		0.00
Spec Imp (sec)	463.4		0.0	442.1		0.0
Mass Changes (kg or t)						
Dry Stage Jettisoned	6.00		0.00	6.30		0.00
Probes Separated			17.31			23.56
AeroBrake Separated			13.10			0.00
Drop Mass Left			0.00			0.00
Sample Mass Added			0.00			0.00

File Name: Loaded Case

(Converged)

PERFORMANCE SUMMARY

Stay Time (days)	Depart		Arrive		Flight Time (days)
	Earth	SEP 8, 2022, 12.0000 hours GMT Julian Date 59831.0000	Mars	MAR 27, 2023, 12.0000 hours GMT Julian Date 60031.0000	200.0000
514.9959	Mars	AUG 23, 2024, 11.9006 hours GMT Julian Date 60545.9959	Earth	MAR 11, 2025, 11.9006 hours GMT Julian Date 60745.9959	200.0000
				Total Duration	914.9959

SPACECRAFT MASS SUMMARY (kg or t)

		Depart			Arrive								
Leg	Initial	Engine	Propell	Tankage	Engine	Propell	Tankage	Inert	Probes	AeroBrk	Drops	Samples	NetMass
1	118.921	6.000	30.686	0.000	0.000	0.000	0.000	0.000	17.312	13.100	0.000	0.000	51.823
2	51.823	6.300	15.765	0.000	0.000	0.000	0.000	0.000	23.558	0.000	0.000	0.000	6.200

DEPARTURE/ARRIVAL CONDITIONS

	Depart						Arrive					
Leg	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)	V Inf (km/s)	Decl (deg)	Rt Asc (deg)	Brn Tm (min)	Del V (km/s)	VLoss (m/s)
1	4.29603	44.78	59.76	21.111	1.35630	55.737	3.78409	-19.35	186.20	0.000	0.00000	0.000
2	3.83794	0.42	29.07	10.347	1.57251	15.412	6.26432	-8.06	336.53	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.3873347	0.273834617	2.95604	345.50704	358.72118	1.28811	143.52268	1.0074344	1.7672350	596.85702
2	1.1815417	0.233405541	0.32232	170.85059	57.71750	173.15022	302.24574	0.9057634	1.4573201	469.10713

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
800.00000	51.60000	1.35630	11.98622	17.57641	1.26479	0.40064	0.28167
800.00000	51.60000	1.35630	46.32683	347.73845	0.91522	-0.19891	0.98100

MISSION OPERATIONS

	Earth Dep	Helio	Mars Arr	Dep	Helio	Earth Arr
Times (days)						
Depart/Arrive	0.00		200.00	715.00		915.00
Flight/Stay		200.00		515.00	200.00	
Esc/Cap Orbits (radii)						
Apoapse Distance	12.09		0.00	10.95		0.00
Periapse Distance	1.13		0.00	1.07		0.00
Spacecraft Distances (AU)						
Minimum Heliocentric		1.0075			0.9935	
Maximum Heliocentric		1.6457			1.4573	
Geocentric	0.0000		1.4094	1.4798		0.0000
Maneuvers						
Propulsion Type	Vloss		None	Vloss		None
Vinf (km/sec)	4.30		3.78	3.84		6.26
Eff Delta-V (km/sec)	1.36	0.00	0.00	1.57	0.00	0.00
Vel Losses (m/sec)	55.74		0.00	15.41		0.00
Propellant (kg or t)	30.69	0.00	0.00	15.76	0.00	0.00
Burn time (hr)	0.35		0.00	0.17		0.00
Thrust (lbs or klbs)	24.75		0.00	24.75		0.00
Spec Imp (sec)	463.4		0.0	442.1		0.0
Mass Changes (kg or t)						
Dry Stage Jettisoned	6.00		0.00	6.30		0.00
Probes Separated			17.31			23.56
AeroBrake Separated			13.10			0.00
Drop Mass Left			0.00			0.00
Sample Mass Added			0.00			0.00

Input File Name: Loaded Case

Trajectory 1 (Converged)

PERFORMANCE SUMMARY

Leg	Stay Time (days)	Depart		Arrive		Flight Time (days)
1		Earth	SEP 9, 2022, 12.0000 hours GMT Julian Date 59832.0000	Mars	MAR 28, 2023, 12.0000 hours GMT Julian Date 60032.0000	200.0000
2	513.9959	Mars	AUG 23, 2024, 11.9005 hours GMT Julian Date 60545.9959	Earth	MAR 11, 2025, 11.9005 hours GMT Julian Date 60745.9959	200.0000
					Total Duration	913.9959

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Depart Engine	Depart Propell	Depart Tankage	Arrive Engine	Arrive Propell	Arrive Tankage	Inert	Probes	AeroBrk	Drops	Samples	NetMass
1	118.952	6.000	30.717	0.000	0.000	0.000	0.000	0.000	17.312	13.100	0.000	0.000	51.823
2	51.823	6.300	15.765	0.000	0.000	0.000	0.000	0.000	23.558	0.000	0.000	0.000	6.200

DEPARTURE/ARRIVAL CONDITIONS

Leg	Depart V Inf (km/s)	Depart Decl (deg)	Depart Rt Asc (deg)	Depart Brn Tm (min)	Depart Del V (km/s)	Depart VLoss (m/s)	Arrive V Inf (km/s)	Arrive Decl (deg)	Arrive Rt Asc (deg)	Arrive Brn Tm (min)	Arrive Del V (km/s)	Arrive VLoss (m/s)
1	4.29871	44.33	58.70	21.132	1.35748	55.905	3.74844	-19.22	186.33	0.000	0.00000	0.000
2	3.83794	0.42	29.07	10.347	1.57251	15.412	6.26432	-8.06	336.53	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.3857809	0.273290302	2.92626	346.47904	357.71749	2.29092	144.00226	1.0070604	1.7645014	595.85459
2	1.1815417	0.233405512	0.32232	170.85059	57.71749	173.15022	302.24574	0.9057634	1.4573201	469.10712

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
800.00000	51.60000	1.35748	11.29056	17.06114	1.27263	0.39057	0.26577
800.00000	51.60000	1.35748	46.73100	346.78866	0.90583	-0.21265	0.98844

MISSION OPERATIONS

	Earth Dep	Helio	Mars Arr	Mars Dep	Helio	Earth Arr
Times (days)						
Depart/Arrive	0.00		200.00	714.00		914.00
Flight/Stay		200.00	514.00		200.00	
Esc/Cap Orbits (radii)						
Apoapse Distance	12.09		0.00	10.95		0.00
Periapse Distance	1.13		0.00	1.07		0.00
Spacecraft Distances (AU)						
Minimum Heliocentric		1.0072			0.9935	
Maximum Heliocentric		1.6463			1.4573	
Geocentric	0.0000		1.4193	1.4798		0.0000
Maneuvers						
Propulsion Type	Vloss		None	Vloss		None
Vinf (km/sec)	4.30		3.75	3.84		6.26
Eff Delta-V (km/sec)	1.36	0.00	0.00	1.57	0.00	0.00
Vel Losses (m/sec)	55.90		0.00	15.41		0.00
Propellant (kg or t)	30.72	0.00	0.00	15.76	0.00	0.00
Burn time (hr)	0.35		0.00	0.17		0.00
Thrust (lbs or klbs)	24.75		0.00	24.75		0.00
Spec Imp (sec)	463.4		0.0	442.1		0.0
Mass Changes (kg or t)						
Dry Stage Jettisoned	6.00		0.00	6.30		0.00
Probes Separated			17.31			23.56
AeroBrake Separated			13.10			0.00
Drop Mass Left			0.00			0.00
Sample Mass Added			0.00			0.00

File Name: Loaded Case

(Converged)

PERFORMANCE SUMMARY

Stay Time (days)	Depart		Arrive		Flight Time (days)
	Earth	SEP 10, 2022, 12.0000 hours GMT Julian Date 59833.0000	Mars	MAR 29, 2023, 12.0000 hours GMT Julian Date 60033.0000	200.0000
512.9959	Mars	AUG 23, 2024, 11.9004 hours GMT Julian Date 60545.9959	Earth	MAR 11, 2025, 11.9004 hours GMT Julian Date 60745.9959	200.0000
				Total Duration	912.9959

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Depart Engine	Depart Propell	Depart Tankage	Arrive Engine	Arrive Propell	Arrive Tankage	Inert	Probes	AeroBrk	Drops	Samples	NetMass
1	119.024	6.000	30.789	0.000	0.000	0.000	0.000	0.000	17.312	13.100	0.000	0.000	51.823
2	51.823	6.300	15.765	0.000	0.000	0.000	0.000	0.000	23.558	0.000	0.000	0.000	6.200

DEPARTURE/ARRIVAL CONDITIONS

Leg	Depart V Inf (km/s)	Depart Decl (deg)	Depart Rt Asc (deg)	Depart Brn Tm (min)	Depart Del V (km/s)	Depart VLoss (m/s)	Arrive V Inf (km/s)	Arrive Decl (deg)	Arrive Rt Asc (deg)	Arrive Brn Tm (min)	Arrive Del V (km/s)	Arrive VLoss (m/s)
1	4.30496	43.86	57.65	21.182	1.36024	56.299	3.71291	-19.08	186.44	0.000	0.00000	0.000
2	3.83794	0.42	29.07	10.347	1.57251	15.412	6.26432	-8.06	336.53	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.3841920	0.272776903	2.89717	347.45155	356.70365	3.30386	144.49113	1.0066164	1.7617676	594.83008
2	1.1815417	0.233405482	0.32232	170.85060	57.71748	173.15022	302.24575	0.9057634	1.4573200	469.10711

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
800.00000	51.60000	1.36024	10.60236	16.57202	1.28148	0.38134	0.25027
800.00000	51.60000	1.36024	47.13919	345.92768	0.89749	-0.22497	0.99707

MISSION OPERATIONS

	Earth Dep	Helio	Mars Arr	Mars Dep	Helio	Earth Arr
Times (days)						
Depart/Arrive	0.00		200.00	713.00		913.00
Flight/Stay		200.00		513.00	200.00	
Esc/Cap Orbits (radii)						
Apoapse Distance	12.09		0.00	10.95		0.00
Periapse Distance	1.13		0.00	1.07		0.00
Spacecraft Distances (AU)						
Minimum Heliocentric		1.0070			0.9935	
Maximum Heliocentric		1.6469			1.4573	
Geocentric	0.0000		1.4292	1.4798		0.0000
Maneuvers						
Propulsion Type	Vloss		None	Vloss		None
Vinf (km/sec)	4.30		3.71	3.84		6.26
Eff Delta-V (km/sec)	1.36	0.00	0.00	1.57	0.00	0.00
Vel Losses (m/sec)	56.30		0.00	15.41		0.00
Propellant (kg or t)	30.79	0.00	0.00	15.76	0.00	0.00
Burn time (hr)	0.35		0.00	0.17		0.00
Thrust (lbs or klbs)	24.75		0.00	24.75		0.00
Spec Imp (sec)	463.4		0.0	442.1		0.0
Mass Changes (kg or t)						
Dry Stage Jettisoned	6.00		0.00	6.30		0.00
Probes Separated			17.31			23.56
AeroBrake Separated			13.10			0.00
Drop Mass Left			0.00			0.00
Sample Mass Added			0.00			0.00

File Name: Loaded Case

(Converged)

PERFORMANCE SUMMARY

Stay Time (days)	Depart		Arrive		Flight Time (days)
	Earth	SEP 11, 2022, 12.0000 hours GMT Julian Date 59834.0000	Mars	MAR 30, 2023, 12.0000 hours GMT Julian Date 60034.0000	200.0000
511.9958	Mars	AUG 23, 2024, 11.9003 hours GMT Julian Date 60545.9958	Earth	MAR 11, 2025, 11.9003 hours GMT Julian Date 60745.9958	200.0000
				Total Duration	911.9958

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Depart Engine	Depart Propell	Depart Tankage	Arrive Engine	Arrive Propell	Arrive Tankage	Inert	Probes	AeroBrk	Drops	Samples	NetMass
1	119.138	6.000	30.903	0.000	0.000	0.000	0.000	0.000	17.312	13.100	0.000	0.000	51.823
2	51.823	6.300	15.765	0.000	0.000	0.000	0.000	0.000	23.558	0.000	0.000	0.000	6.200

DEPARTURE/ARRIVAL CONDITIONS

Leg	Depart V Inf (km/s)	Depart Decl (deg)	Depart Rt Asc (deg)	Depart Brn Tm (min)	Depart Del V (km/s)	Depart VLoss (m/s)	Arrive V Inf (km/s)	Arrive Decl (deg)	Arrive Rt Asc (deg)	Arrive Brn Tm (min)	Arrive Del V (km/s)	Arrive VLoss (m/s)
1	4.31482	43.37	56.63	21.260	1.36460	56.926	3.67749	-18.93	186.54	0.000	0.00000	0.000
2	3.83794	0.42	29.07	10.347	1.57251	15.412	6.26432	-8.06	336.53	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.3825683	0.272295783	2.86875	348.42459	355.67973	4.32685	144.98922	1.0061008	1.7590358	593.78375
2	1.1815417	0.233405452	0.32232	170.85060	57.71747	173.15022	302.24576	0.9057634	1.4573200	469.10711

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
800.00000	51.60000	1.36460	9.92414	16.11047	1.29139	0.37300	0.23518
800.00000	51.60000	1.36460	47.54795	345.16235	0.89035	-0.23587	1.00686

MISSION OPERATIONS

	Earth Dep	Helio	Mars Arr	Mars Dep	Helio	Earth Arr
Times (days)						
Depart/Arrive	0.00		200.00	712.00		912.00
Flight/Stay		200.00	512.00		200.00	
Esc/Cap Orbits (radii)						
Apoapse Distance	12.09		0.00	10.95		0.00
Periapse Distance	1.13		0.00	1.07		0.00
Spacecraft Distances (AU)						
Minimum Heliocentric		1.0067			0.9935	
Maximum Heliocentric		1.6475			1.4573	
Geocentric	0.0000		1.4391	1.4798		0.0000
Maneuvers						
Propulsion Type	Vloss		None	Vloss		None
Vinf (km/sec)	4.31		3.68	3.84		6.26
Eff Delta-V (km/sec)	1.36	0.00	0.00	1.57	0.00	0.00
Vel Losses (m/sec)	56.93		0.00	15.41		0.00
Propellant (kg or t)	30.90	0.00	0.00	15.76	0.00	0.00
Burn time (hr)	0.35		0.00	0.17		0.00
Thrust (lbs or klbs)	24.75		0.00	24.75		0.00
Spec Imp (sec)	463.4		0.0	442.1		0.0
Mass Changes (kg or t)						
Dry Stage Jettisoned	6.00		0.00	6.30		0.00
Probes Separated			17.31			23.56
AeroBrake Separated			13.10			0.00
Drop Mass Left			0.00			0.00
Sample Mass Added			0.00			0.00

File Name: Loaded Case

(Converged)

PERFORMANCE SUMMARY

Leg	Stay Time (days)	Depart		Arrive		Flight Time (days)
		Earth	SEP 13, 2022, 12.0000 hours GMT Julian Date 59836.0000	Mars	APR 1, 2023, 12.0000 hours GMT Julian Date 60036.0000	200.0000
	509.9958	Mars	AUG 23, 2024, 11.9001 hours GMT Julian Date 60545.9958	Earth	MAR 11, 2025, 11.9001 hours GMT Julian Date 60745.9958	200.0000
					Total Duration	909.9958

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Depart Engine	Depart Propell	Depart Tankage	Arrive Engine	Arrive Propell	Arrive Tankage	Inert	Probes	AeroBrk	Drops	Samples	NetMass
1	119.497	6.000	31.262	0.000	0.000	0.000	0.000	0.000	17.312	13.100	0.000	0.000	51.823
2	51.823	6.300	15.765	0.000	0.000	0.000	0.000	0.000	23.558	0.000	0.000	0.000	6.200

DEPARTURE/ARRIVAL CONDITIONS

Leg	Depart V Inf (km/s)	Depart Decl (deg)	Depart Rt Asc (deg)	Depart Brn Tm (min)	Depart Del V (km/s)	Depart VLoss (m/s)	Arrive V Inf (km/s)	Arrive Decl (deg)	Arrive Rt Asc (deg)	Arrive Brn Tm (min)	Arrive Del V (km/s)	Arrive VLoss (m/s)
1	4.34547	42.35	54.65	21.507	1.37824	58.925	3.60710	-18.61	186.68	0.000	0.00000	0.000
2	3.83794	0.42	29.07	10.347	1.57251	15.412	6.26431	-8.06	336.53	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.3792178	0.271435907	2.81381	350.37226	353.60205	6.40262	146.01269	1.0048486	1.7535870	591.62661
2	1.1815417	0.233405392	0.32232	170.85060	57.71745	173.15022	302.24577	0.9057635	1.4573199	469.10709

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
800.00000	51.60000	1.37824	8.60769	15.27520	1.31458	0.35902	0.20628
800.00000	51.60000	1.37824	48.35293	343.94129	0.88016	-0.25336	1.02990

MISSION OPERATIONS

	Earth Dep	Helio	Mars Arr	Mars Dep	Helio	Earth Arr
Times (days)						
Depart/Arrive	0.00		200.00	710.00		910.00
Flight/Stay		200.00		510.00	200.00	
Esc/Cap Orbits (radii)						
Apoapse Distance	12.09		0.00	10.95		0.00
Periapse Distance	1.13		0.00	1.07		0.00
Spacecraft Distances (AU)						
Minimum Heliocentric		1.0062			0.9935	
Maximum Heliocentric		1.6487			1.4573	
Geocentric	0.0000		1.4588	1.4798		0.0000
Maneuvers						
Propulsion Type	Vloss		None	Vloss		None
Vinf (km/sec)	4.35		3.61	3.84		6.26
Eff Delta-V (km/sec)	1.38	0.00	0.00	1.57	0.00	0.00
Vel Losses (m/sec)	58.92		0.00	15.41		0.00
Propellant (kg or t)	31.26	0.00	0.00	15.76	0.00	0.00
Burn time (hr)	0.36		0.00	0.17		0.00
Thrust (lbs or klbs)	24.75		0.00	24.75		0.00
Spec Imp (sec)	463.4		0.0	442.1		0.0
Mass Changes (kg or t)						
Dry Stage Jettisoned	6.00		0.00	6.30		0.00
Probes Separated			17.31			23.56
AeroBrake Separated			13.10			0.00
Drop Mass Left			0.00			0.00
Sample Mass Added			0.00			0.00

File Name: Loaded Case

Case 1 (Converged)

PERFORMANCE SUMMARY

Leg	Stay Time (days)	Depart		Arrive		Flight Time (days)
1		Earth	SEP 14, 2022, 4.0671 hours GMT Julian Date 59836.6695	Mars	APR 2, 2023, 4.0671 hours GMT Julian Date 60036.6695	200.0000
	509.3264	Mars	AUG 23, 2024, 11.9000 hours GMT Julian Date 60545.9958	Earth	MAR 11, 2025, 11.9000 hours GMT Julian Date 60745.9958	200.0000
					Total Duration	909.3264

last day for $C_3 = 19$

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Depart Engine	Depart Propell	Depart Tankage	Arrive Engine	Arrive Propell	Arrive Tankage	Inert	Probes	AeroBrk	Drops	Samples	NetMass
1	119.656	6.000	31.421	0.000	0.000	0.000	0.000	0.000	17.312	13.100	0.000	0.000	51.823
2	51.823	6.300	15.765	0.000	0.000	0.000	0.000	0.000	23.558	0.000	0.000	0.000	6.200

DEPARTURE/ARRIVAL CONDITIONS

Leg	Depart V Inf (km/s)	Depart Decl (deg)	Depart Rt Asc (deg)	Depart Brn Tm (min)	Depart Del V (km/s)	Depart VLoss (m/s)	Arrive V Inf (km/s)	Arrive Decl (deg)	Arrive Rt Asc (deg)	Arrive Brn Tm (min)	Arrive Del V (km/s)	Arrive VLoss (m/s)
1	4.35900	42.00	54.01	21.617	1.38432	59.831	3.58369	-18.49	186.71	0.000	0.00000	0.000
2	3.83794	0.42	29.07	10.347	1.57251	15.412	6.26431	-8.06	336.53	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.3780659	0.271180095	2.79597	351.02468	352.89782	7.10619	146.36329	1.0043619	1.7517700	590.88563
2	1.1815417	0.233405372	0.32232	170.85060	57.71744	173.15022	302.24578	0.9057635	1.4573199	469.10709

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
800.00000	51.60000	1.38432	8.18158	15.02302	1.32339	0.35517	0.19700
800.00000	51.60000	1.38432	48.61476	343.62964	0.87809	-0.25794	1.03863

MISSION OPERATIONS

	Earth Dep	Earth Helio	Mars Arr	Mars Dep	Mars Helio	Earth Arr
Times (days)						
Depart/Arrive	0.00		200.00	709.33		909.33
Flight/Stay		200.00		509.33	200.00	
Disc/Cap Orbits (radii)						
Apoapse Distance	12.09		0.00	10.95		0.00
Periapse Distance	1.13		0.00	1.07		0.00
Spacecraft Distances (AU)						
Minimum Heliocentric		1.0060			0.9935	
Maximum Heliocentric		1.6490			1.4573	
Geocentric	0.0000		1.4654	1.4798		0.0000
Maneuvers						
Propulsion Type	Vloss		None	Vloss		None
Vinf (km/sec)	4.36		3.58	3.84		6.26
Eff Delta-V (km/sec)	1.38	0.00	0.00	1.57	0.00	0.00
Vel Losses (m/sec)	59.83		0.00	15.41		0.00
Propellant (kg or t)	31.42	0.00	0.00	15.76	0.00	0.00
Burn time (hr)	0.36		0.00	0.17		0.00
Thrust (lbs or klbs)	24.75		0.00	24.75		0.00
Spec Imp (sec)	463.4		0.0	442.1		0.0
Mass Changes (kg or t)						
Dry Stage Jettisoned	6.00		0.00	6.30		0.00
Probes Separated			17.31			23.56
AeroBrake Separated			13.10			0.00
Drop Mass Left			0.00			0.00
Sample Mass Added			0.00			0.00

File Name: Loaded Case

1 (Converged)

PERFORMANCE SUMMARY

Leg	Stay Time (days)	Depart		Arrive		Flight Time (days)
1		Earth	OCT 8, 2024, 12.0000 hours GMT Julian Date 60592.0000	Mars	MAY 5, 2025, 4.4291 hours GMT Julian Date 60800.6845	208.6845
2	513.2570	Mars	SEP 30, 2026, 10.5960 hours GMT Julian Date 61313.9415	Earth	APR 18, 2027, 10.5960 hours GMT Julian Date 61513.9415	200.0000
					Total Duration	921.9415

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Depart Engine	Depart Propell	Depart Tankage	Arrive Engine	Arrive Propell	Arrive Tankage	Inert	Probes	AeroBrk	Drops	Samples	NetMass
1	118.695	6.000	30.590	0.000	0.000	0.000	0.000	0.000	17.312	13.100	0.000	0.000	51.693
2	51.693	6.300	15.635	0.000	0.000	0.000	0.000	0.000	23.558	0.000	0.000	0.000	6.200

DEPARTURE/ARRIVAL CONDITIONS

Leg	Depart V Inf (km/s)	Depart Decl (deg)	Depart Rt Asc (deg)	Depart Brn Tm (min)	Depart Del V (km/s)	Depart VLoss (m/s)	Arrive V Inf (km/s)	Arrive Decl (deg)	Arrive Rt Asc (deg)	Arrive Brn Tm (min)	Arrive Del V (km/s)	Arrive VLoss (m/s)
1	4.29200	48.90	108.57	21.045	1.35434	55.296	4.82626	-29.11	232.32	0.000	0.00000	0.000
2	3.82106	15.24	49.80	10.262	1.56167	15.033	6.81300	-1.78	11.02	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.3868010	0.279785537	3.23528	15.38136	2.69835	357.28155	146.01688	0.9987941	1.7748078	596.51260
2	1.2361880	0.260104758	1.27868	27.87954	235.25057	181.89730	304.67056	0.9146496	1.5577263	502.02482

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
800.00000	51.60000	1.35434	19.64712	59.68520	0.64381	1.10109	0.45536
800.00000	51.60000	1.35434	41.23676	37.90962	0.80354	0.62576	0.89274

MISSION OPERATIONS

	Earth Dep	Helio	Mars Arr	Mars Dep	Helio	Earth Arr
Times (days)						
Depart/Arrive	0.00		208.68	721.94		921.94
Flight/Stay		208.68		513.26	200.00	
Esc/Cap Orbits (radii)						
Apoapse Distance	12.09		0.00	10.95		0.00
Periapse Distance	1.13		0.00	1.07		0.00
Spacecraft Distances (AU)						
Minimum Heliocentric		0.9988			1.0040	
Maximum Heliocentric		1.6644			1.5574	
Geocentric	0.0000		1.4604	1.6690		0.0000
Maneuvers						
Propulsion Type	Vloss		None	Vloss		None
Vinf (km/sec)	4.29		4.83	3.82		6.81
Eff Delta-V (km/sec)	1.35	0.00	0.00	1.56	0.00	0.00
Vel Losses (m/sec)	55.30		0.00	15.03		0.00
Propellant (kg or t)	30.59	0.00	0.00	15.64	0.00	0.00
Burn time (hr)	0.35		0.00	0.17		0.00
Thrust (lbs or klbs)	24.75		0.00	24.75		0.00
Spec Imp (sec)	463.4		0.0	442.1		0.0
Mass Changes (kg or t)						
Dry Stage Jettisoned	6.00		0.00	6.30		0.00
Probes Separated			17.31			23.56
AeroBrake Separated			13.10			0.00
Drop Mass Left			0.00			0.00
Sample Mass Added			0.00			0.00

Input File Name: Loaded Case

Type 1 (Converged)

PERFORMANCE SUMMARY

Leg	Stay Time (days)	Depart		Arrive		Flight Time (days)
1		Earth	OCT 10, 2024, 12.0000 hours GMT Julian Date 60594.0000	Mars	MAY 2, 2025, 11.1837 hours GMT Julian Date 60797.9660	203.9660
2	515.9755	Mars	SEP 30, 2026, 10.5955 hours GMT Julian Date 61313.9415	Earth	APR 18, 2027, 10.5955 hours GMT Julian Date 61513.9415	200.0000
					Total Duration	919.9415

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Depart Engine	Depart Propell	Depart Tankage	Arrive Engine	Arrive Propell	Arrive Tankage	Inert	Probes	AeroBrk	Drops	Samples	NetMass
1	118.695	6.000	30.590	0.000	0.000	0.000	0.000	0.000	17.312	13.100	0.000	0.000	51.693
2	51.693	6.300	15.635	0.000	0.000	0.000	0.000	0.000	23.558	0.000	0.000	0.000	6.200

DEPARTURE/ARRIVAL CONDITIONS

Leg	Depart V Inf (km/s)	Depart Decl (deg)	Depart Rt Asc (deg)	Depart Brn Tm (min)	Depart Del V (km/s)	Depart VLoss (m/s)	Arrive V Inf (km/s)	Arrive Decl (deg)	Arrive Rt Asc (deg)	Arrive Brn Tm (min)	Arrive Del V (km/s)	Arrive VLoss (m/s)
1	4.29200	46.98	107.40	21.045	1.35434	55.296	4.98228	-27.84	232.67	0.000	0.00000	0.000
2	3.82106	15.24	49.80	10.262	1.56167	15.033	6.81300	-1.78	11.02	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.3937281	0.283642741	2.99740	17.36082	1.30228	358.67403	144.24864	0.9984072	1.7890490	600.98760
2	1.2361879	0.260104738	1.27868	27.87954	235.25056	181.89729	304.67055	0.9146496	1.5577262	502.02478

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
800.00000	51.60000	1.35434	15.71553	62.15622	0.60892	1.15277	0.36684
800.00000	51.60000	1.35434	44.01033	35.50621	0.79294	0.56573	0.94098

MISSION OPERATIONS

	Earth Dep	Helio	Mars Arr	Mars Dep	Helio	Earth Arr
Times (days)						
Depart/Arrive	0.00		203.97	719.94		919.94
Flight/Stay		203.97		515.98	200.00	
Esc/Cap Orbits (radii)						
Apoapse Distance	12.09		0.00	10.95		0.00
Periapse Distance	1.13		0.00	1.07		0.00
Spacecraft Distances (AU)						
Minimum Heliocentric		0.9984			1.0040	
Maximum Heliocentric		1.6648			1.5574	
Geocentric	0.0000		1.4354	1.6690		0.0000
Maneuvers						
Propulsion Type	Vloss		None	Vloss		None
Vinf (km/sec)	4.29		4.98	3.82		6.81
Eff Delta-V (km/sec)	1.35	0.00	0.00	1.56	0.00	0.00
Vel Losses (m/sec)	55.30		0.00	15.03		0.00
Propellant (kg or t)	30.59	0.00	0.00	15.64	0.00	0.00
Burn time (hr)	0.35		0.00	0.17		0.00
Thrust (lbs or klbs)	24.75		0.00	24.75		0.00
Spec Imp (sec)	463.4		0.0	442.1		0.0
Mass Changes (kg or t)						
Dry Stage Jettisoned	6.00		0.00	6.30		0.00
Probes Separated			17.31			23.56
AeroBrake Separated			13.10			0.00
Drop Mass Left			0.00			0.00
Sample Mass Added			0.00			0.00

File Name: Loaded Case

1 (Converged)

PERFORMANCE SUMMARY

Stay Time (days)	Depart		Arrive		Flight Time (days)
	Earth	OCT 12, 2024, 12.0000 hours GMT Julian Date 60596.0000	Mars	MAY 2, 2025, 0.4686 hours GMT Julian Date 60797.5195	201.5195
516.4219	Mars	SEP 30, 2026, 10.5950 hours GMT Julian Date 61313.9415	Earth	APR 18, 2027, 10.5950 hours GMT Julian Date 61513.9415	200.0000
				Total Duration	917.9415

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Depart Engine	Depart Propell	Depart Tankage	Arrive Engine	Arrive Propell	Arrive Tankage	Inert	Probes	AeroBrk	Drops	Samples	NetMass
1	118.695	6.000	30.590	0.000	0.000	0.000	0.000	0.000	17.312	13.100	0.000	0.000	51.693
2	51.693	6.300	15.635	0.000	0.000	0.000	0.000	0.000	23.558	0.000	0.000	0.000	6.200

DEPARTURE/ARRIVAL CONDITIONS

Leg	Depart V Inf (km/s)	Depart Decl (deg)	Depart Rt Asc (deg)	Depart Brn Tm (min)	Depart Del V (km/s)	Depart VLoss (m/s)	Arrive V Inf (km/s)	Arrive Decl (deg)	Arrive Rt Asc (deg)	Arrive Brn Tm (min)	Arrive Del V (km/s)	Arrive VLoss (m/s)
1	4.29200	45.86	105.46	21.045	1.35434	55.296	5.02196	-27.09	232.99	0.000	0.00000	0.000
2	3.82106	15.24	49.80	10.262	1.56167	15.033	6.81300	-1.78	11.02	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.3952564	0.284799605	2.84632	19.34228	359.53967	0.43332	143.83732	0.9978879	1.7926249	601.97640
2	1.2361878	0.260104717	1.27868	27.87954	235.25055	181.89728	304.67054	0.9146495	1.5577261	502.02474

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
800.00000	51.60000	1.35434	13.73068	61.88002	0.62009	1.16034	0.32146
800.00000	51.60000	1.35434	45.27230	33.35667	0.79609	0.52406	0.96220

MISSION OPERATIONS

	Earth Dep	Helio	Mars Arr	Mars Dep	Helio	Earth Arr
Times (days)						
Depart/Arrive	0.00		201.52	717.94		917.94
Flight/Stay		201.52	516.42		200.00	
Esc/Cap Orbits (radii)						
Apoapse Distance	12.09		0.00	10.95		0.00
Periapse Distance	1.13		0.00	1.07		0.00
Spacecraft Distances (AU)						
Minimum Heliocentric		0.9979			1.0040	
Maximum Heliocentric		1.6649			1.5574	
Geocentric	0.0000		1.4313	1.6690		0.0000
Maneuvers						
Propulsion Type	Vloss		None	Vloss		None
Vinf (km/sec)	4.29		5.02	3.82		6.81
Eff Delta-V (km/sec)	1.35	0.00	0.00	1.56	0.00	0.00
Vel Losses (m/sec)	55.30		0.00	15.03		0.00
Propellant (kg or t)	30.59	0.00	0.00	15.64	0.00	0.00
Burn time (hr)	0.35		0.00	0.17		0.00
Thrust (lbs or klbs)	24.75		0.00	24.75		0.00
Spec Imp (sec)	463.4		0.0	442.1		0.0
Mass Changes (kg or t)						
Dry Stage Jettisoned	6.00		0.00	6.30		0.00
Probes Separated			17.31			23.56
AeroBrake Separated			13.10			0.00
Drop Mass Left			0.00			0.00
Sample Mass Added			0.00			0.00

File Name: Loaded Case

Trip 1 * (Converged)

PERFORMANCE SUMMARY

Leg	Stay Time (days)	Depart		Arrive		Flight Time (days)
		Earth	OCT 14, 2024, 12.0000 hours GMT Julian Date 60598.0000	Mars	MAY 3, 2025, 8.0684 hours GMT Julian Date 60798.8362	200.8362
	515.1053	Mars	SEP 30, 2026, 10.5946 hours GMT Julian Date 61313.9414	Earth	APR 18, 2027, 10.5946 hours GMT Julian Date 61513.9414	200.0000
					Total Duration	915.9414

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Depart Engine	Depart Propell	Depart Tankage	Arrive Engine	Arrive Propell	Arrive Tankage	Inert	Probes	AeroBrk	Drops	Samples	NetMass
1	118.695	6.000	30.590	0.000	0.000	0.000	0.000	0.000	17.312	13.100	0.000	0.000	51.693
2	51.693	6.300	15.635	0.000	0.000	0.000	0.000	0.000	23.558	0.000	0.000	0.000	6.200

DEPARTURE/ARRIVAL CONDITIONS

Leg	Depart V Inf (km/s)	Depart Decl (deg)	Depart Rt Asc (deg)	Depart Brn Tm (min)	Depart Del V (km/s)	Depart VLoss (m/s)	Arrive V Inf (km/s)	Arrive Decl (deg)	Arrive Rt Asc (deg)	Arrive Brn Tm (min)	Arrive Del V (km/s)	Arrive VLoss (m/s)
1	4.29200	45.17	102.84	21.045	1.35434	55.296	4.96471	-26.65	233.31	0.000	0.00000	0.000
2	3.82106	15.24	49.80	10.262	1.56167	15.033	6.81300	-1.78	11.02	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.3921562	0.283763916	2.74406	21.32581	357.45764	2.51223	144.51343	0.9971125	1.7871999	599.97114
2	1.2361878	0.260104696	1.27868	27.87954	235.25054	181.89727	304.67053	0.9146495	1.5577260	502.02469

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
800.00000	51.60000	1.35434	12.58702	60.16505	0.65760	1.14660	0.29514
800.00000	51.60000	1.35434	45.95496	30.74266	0.80925	0.48131	0.97349

MISSION OPERATIONS

	Earth Dep	Helio	Mars Arr	Mars Dep	Helio	Earth Arr
Times (days)						
Depart/Arrive	0.00		200.84	715.94		915.94
Flight/Stay		200.84		515.11	200.00	
Esc/Cap Orbits (radii)						
Apoapse Distance	12.09		0.00	10.95		0.00
Periapse Distance	1.13		0.00	1.07		0.00
Spacecraft Distances (AU)						
Minimum Heliocentric		0.9973			1.0040	
Maximum Heliocentric		1.6647			1.5574	
Geocentric	0.0000		1.4434	1.6690		0.0000
Maneuvers						
Propulsion Type	Vloss		None	Vloss		None
Vinf (km/sec)	4.29		4.96	3.82		6.81
Eff Delta-V (km/sec)	1.35	0.00	0.00	1.56	0.00	0.00
Vel Losses (m/sec)	55.30		0.00	15.03		0.00
Propellant (kg or t)	30.59	0.00	0.00	15.64	0.00	0.00
Burn time (hr)	0.35		0.00	0.17		0.00
Thrust (lbs or klbs)	24.75		0.00	24.75		0.00
Spec Imp (sec)	463.4		0.0	442.1		0.0
Mass Changes (kg or t)						
Dry Stage Jettisoned	6.00		0.00	6.30		0.00
Probes Separated			17.31			23.56
AeroBrake Separated			13.10			0.00
Drop Mass Left			0.00			0.00
Sample Mass Added			0.00			0.00

File Name: Loaded Case

(Converged)

PERFORMANCE SUMMARY

Stay Time (days)	Depart		Arrive		Flight Time (days)
	Earth	OCT 16, 2024, 12.0000 hours GMT Julian Date 60600.0000	Mars	MAY 6, 2025, 22.6385 hours GMT Julian Date 60802.4433	202.4433
511.4982	Mars	SEP 30, 2026, 10.5941 hours GMT Julian Date 61313.9414	Earth	APR 18, 2027, 10.5941 hours GMT Julian Date 61513.9414	200.0000
				Total Duration	913.9414

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Depart Engine	Depart Propell	Depart Tankage	Arrive Engine	Arrive Propell	Arrive Tankage	Inert	Probes	AeroBrk	Drops	Samples	NetMass
1	118.695	6.000	30.590	0.000	0.000	0.000	0.000	0.000	17.312	13.100	0.000	0.000	51.693
2	51.693	6.300	15.635	0.000	0.000	0.000	0.000	0.000	23.558	0.000	0.000	0.000	6.200

DEPARTURE/ARRIVAL CONDITIONS

Leg	Depart V Inf (km/s)	Depart Decl (deg)	Depart Rt Asc (deg)	Depart Brn Tm (min)	Depart Del V (km/s)	Depart VLoss (m/s)	Arrive V Inf (km/s)	Arrive Decl (deg)	Arrive Rt Asc (deg)	Arrive Brn Tm (min)	Arrive Del V (km/s)	Arrive VLoss (m/s)
1	4.29200	44.84	99.34	21.045	1.35434	55.296	4.78347	-26.48	233.63	0.000	0.00000	0.000
2	3.82106	15.24	49.80	10.262	1.56167	15.033	6.81300	-1.78	11.02	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.3834420	0.280110268	2.68532	23.31126	354.96198	5.00510	146.60265	0.9959257	1.7709583	594.34663
2	1.2361877	0.260104676	1.27868	27.87954	235.25053	181.89726	304.67053	0.9146495	1.5577259	502.02463

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
800.00000	51.60000	1.35434	12.05664	57.06835	0.72003	1.11165	0.28289
800.00000	51.60000	1.35434	46.26018	27.27353	0.83227	0.42908	0.97849

MISSION OPERATIONS

	Earth Dep	Helio	Mars Arr	Mars Dep	Helio	Earth Arr
Times (days)						
Depart/Arrive	0.00		202.44	713.94		913.94
Flight/Stay		202.44	511.50		200.00	
Esc/Cap Orbits (radii)						
Apoapse Distance	12.09		0.00	10.95		0.00
Periapse Distance	1.13		0.00	1.07		0.00
Spacecraft Distances (AU)						
Minimum Heliocentric		0.9968			1.0040	
Maximum Heliocentric		1.6640			1.5574	
Geocentric	0.0000		1.4764	1.6690		0.0000
Maneuvers						
Propulsion Type	Vloss		None	Vloss		None
Vinf (km/sec)	4.29		4.78	3.82		6.81
Eff Delta-V (km/sec)	1.35	0.00	0.00	1.56	0.00	0.00
Vel Losses (m/sec)	55.30		0.00	15.03		0.00
Propellant (kg or t)	30.59	0.00	0.00	15.64	0.00	0.00
Burn time (hr)	0.35		0.00	0.17		0.00
Thrust (lbs or klbs)	24.75		0.00	24.75		0.00
Spec Imp (sec)	463.4		0.0	442.1		0.0
Mass Changes (kg or t)						
Dry Stage Jettisoned	6.00		0.00	6.30		0.00
Probes Separated			17.31			23.56
AeroBrake Separated			13.10			0.00
Drop Mass Left			0.00			0.00
Sample Mass Added			0.00			0.00

File Name: Loaded Case

1 (Converged)

PERFORMANCE SUMMARY

Leg	Stay Time (days)	Depart		Arrive		Flight Time (days)
		Earth	OCT 18, 2024, 12.0000 hours GMT Julian Date 60602.0000	Mars	MAY 15, 2025, 13.8983 hours GMT Julian Date 60811.0791	209.0791
	502.8623	Mars	SEP 30, 2026, 10.5936 hours GMT Julian Date 61313.9414	Earth	APR 18, 2027, 10.5936 hours GMT Julian Date 61513.9414	200.0000
					Total Duration	911.9414

SPACECRAFT MASS SUMMARY (kg or t)

Leg	Initial	Depart Engine	Depart Propell	Depart Tankage	Arrive Engine	Arrive Propell	Arrive Tankage	Inert	Probes	AeroBrk	Drops	Samples	NetMass
1	118.695	6.000	30.590	0.000	0.000	0.000	0.000	0.000	17.312	13.100	0.000	0.000	51.693
2	51.693	6.300	15.635	0.000	0.000	0.000	0.000	0.000	23.558	0.000	0.000	0.000	6.200

DEPARTURE/ARRIVAL CONDITIONS

Leg	Depart V Inf (km/s)	Depart Decl (deg)	Depart Rt Asc (deg)	Depart Brn Tm (min)	Depart Del V (km/s)	Depart VLoss (m/s)	Arrive V Inf (km/s)	Arrive Decl (deg)	Arrive Rt Asc (deg)	Arrive Brn Tm (min)	Arrive Del V (km/s)	Arrive VLoss (m/s)
1	4.29200	45.10	94.13	21.045	1.35434	55.296	4.35801	-26.85	233.76	0.000	0.00000	0.000
2	3.82106	15.24	49.80	10.262	1.56167	15.033	6.81300	-1.78	11.02	0.000	0.00000	0.000

HELIOCENTRIC TRANSFER ORBIT ELEMENTS

Leg	Semi-Axis (AU)	Eccentricity	Inclination (deg)	Asc Node (deg)	Arg Per (deg)	Departure True Anom (deg)	Arrival True Anom (deg)	Perihelion (AU)	Aphelion (AU)	Period (days)
1	1.3650918	0.271865766	2.70347	25.29803	351.67753	8.28769	151.68367	0.9939701	1.7362135	582.56073
2	1.2361876	0.260104655	1.27868	27.87954	235.25052	181.89725	304.67052	0.9146495	1.5577258	502.02461

LAUNCH DELTA V ORIENTATION - PLANETOCENTRIC

Altitude (km)	Inclination (deg)	Delta V (km/sec)	Declination (deg)	Rt Ascension (deg)	X Dot (km/sec)	Y Dot (km/sec)	Z Dot (km/sec)
800.00000	51.60000	1.35434	12.46738	51.54822	0.82234	1.03562	0.29238
800.00000	51.60000	1.35434	46.02445	22.03937	0.87167	0.35287	0.97463

MISSION OPERATIONS

	Earth Dep	Helio	Mars Arr	Mars Dep	Helio	Earth Arr
Times (days)						
Depart/Arrive	0.00		209.08	711.94		911.94
Flight/Stay		209.08	502.86		200.00	
Esc/Cap Orbits (radii)						
Apoapse Distance	12.09		0.00	10.95		0.00
Periapse Distance	1.13		0.00	1.07		0.00
Spacecraft Distances (AU)						
Minimum Heliocentric		0.9962			1.0040	
Maximum Heliocentric		1.6620			1.5574	
Geocentric	0.0000		1.5541	1.6690		0.0000
Maneuvers						
Propulsion Type	Vloss		None	Vloss		None
Vinf (km/sec)	4.29		4.36	3.82		6.81
Eff Delta-V (km/sec)	1.35	0.00	0.00	1.56	0.00	0.00
Vel Losses (m/sec)	55.30		0.00	15.03		0.00
Propellant (kg or t)	30.59	0.00	0.00	15.64	0.00	0.00
Burn time (hr)	0.35		0.00	0.17		0.00
Thrust (lbs or klbs)	24.75		0.00	24.75		0.00
Spec Imp (sec)	463.4		0.0	442.1		0.0
Mass Changes (kg or t)						
Dry Stage Jettisoned	6.00		0.00	6.30		0.00
Probes Separated			17.31			23.56
AeroBrake Separated			13.10			0.00
Drop Mass Left			0.00			0.00
Sample Mass Added			0.00			0.00

REPORT DOCUMENTATION PAGE

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